

## ROADS AND STREETS



## "THAT'S DOZIN'!"

The "Tournadozer", shown at work above, is one of the latest additions to the LeTourneau line of modern earth movers. It was

designed to do bulldozing faster - with maximum efficiency and economy; it looks the part -and acts it.

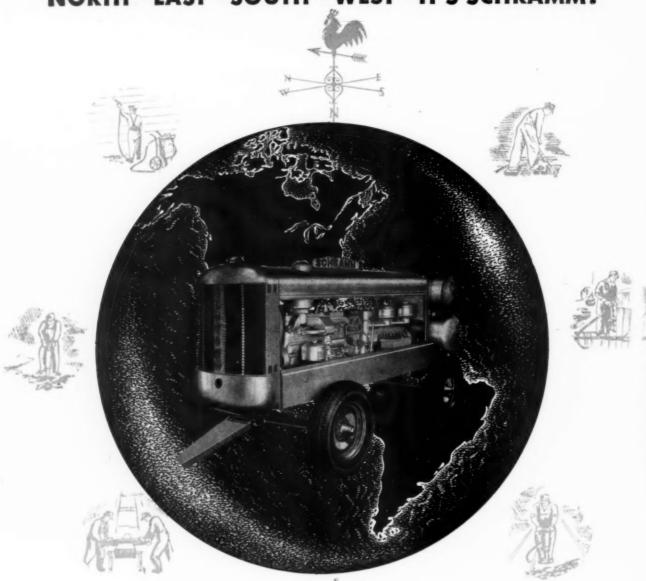
As in all LeTourneau equipment, Timken tapered toller bearings are important factors of high performance, low maintenance and long equipment life. They are used to support all four wheels of the Tournadozer to keep them turning smoothly and easily and to provide ample wheel stability under all conditions of operation. Timken bearings also are used in the air power control unit of this machine.

Everything you need in bearings for any purpose you get in Timken bearings - freedom from friction; all-load capacity - radial load, thrust load or both together in any combination; and alignment of moving parts. See that you have them in your machines. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address "Timrosco".

MT JUST A BALL 🔘 NOT JUST A ROLLER 🥽 THE TIMKEN TAPERED ROLLER 🥽 BEARING TAKES RADIAL 🐧 AND THRUST 🛶 🗕 LOADS OR ANY COMBINATION 🛣



NORTH \* EAST \* SOUTH \* WEST \* IT'S SCHRAMM!



## DOING JOBS LIKE THESE ... throughout



### TOOLS for the JOB

Schramm Inc. also has a complete line of Pneumatic Tools to offer and recommend for operation by their Compressors.

These include Rock Drills, Paving Breakers, Trench Diggers, Clay Spades, Backfill Tampers, Tie Tampers, Sheeting Drivers, Demolition Tools, Chain and Circular Saws.

Write for bulletins and prices.

Rock Drilling Concrete Breaking Demolition

At almost every turn you need compressed air!

The above check list indicates some of the many compressed air jobs to be done, all of which are accomplished easily, quickly and economically with Schramm Air Compressors.

Here's why you profit, as others have, by using Schramm: they're compact, lightweight, easy to start; built for rugged jobs, to provide a continuous flow of air. Important features include 100% water cooled; mechanical intake valve;

forced feed lubrication and easy, electric push-button starting.

Performance everywhere has proved Schramm Air Compressors can do any compressed air job you require. Write today for list of models and sizes.

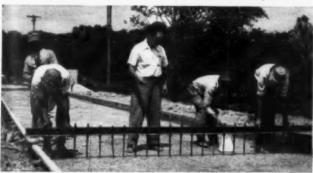
THE COMPRESSOR PEOPLE . WEST CHESTER . PENNSYLVANIA



## Eliminating Dangerous Curve on U.S. Route 1



View of project looking north. New construction under way at left.



Preparatory to first pour, workmen use scratchboard to test subgrade for depth.

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NIA



Close-up of Bethlehem Reinforcing Bars, 291 tons of which were used in new bridge.



Henry Acchione (left) of Acchione Contracting Co., discusses bridge specifications with (left to right): Charles A. Burn, resident engineer, Pa. Dept of Highways, partner Daniel Acchione, and Richard Allen, senior construction inspector, Pa. Dept. of Highways.

The combination of a steep hill, sharp turn, and narrow bridge had long brought trouble to motorists using U. S. Route 1 at Ridley Creek, Media, Pa. To eliminate this traffic hazard, the Pennsylvania Department of Highways recently undertook some 3240 ft of 4-lane relocation, including construction of a 152-ft bridge. Acchione Contracting Co., Philadelphia, had the contract. Bar mats, dowel units and bridge reinforcing were furnished by Bethlehem.

#### BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation Export Distributor: Bethlehem Steel Export Corporation

### STEEL FOR HIGHWAYS

Dowel Units · Reinforcing Bars · Guard Rail Posts Bar Mats · Guard Rail · Wire Rope and Strand Hollow Drill Steel · Spikes · Bolts and Nuts · Pipe Sheet and H-Piling · Fabricated Structural Steel Timber Bridge Hardware · Tie-Rods

## **ROADS AND STREETS**

SEPTEMBER, 1948 VOL. 91 No. 9

With Roads and Streets Have Been Combined Good Roads Magazine And Engineering & Contracting

## In This Issue

#### **Coming Articles**

#### B-36 Base in the Maine Woods

camera-and-notebook tour of the \$13,000,000 project at Limestone

#### TNT on the Menu

How used on an Indiana road job

#### 5779 Feet of Concrete per Day

With Arute Bros. on U.S. 20, New York state

#### A Low Cost Bridge Design

. . . as developed in Texas for secondary roads

#### Forming Bituminous Ditches and Curbs

Devices used by two California contractors

#### Fall and Winter Problems

Continuing with articles on this timely subject, from St. Paul, N. Dakota, Pennsyl-vania, Connecticut

#### With Clyde Wood

. . . up on the Ridge in California— another "Contractors at Work" picture story

#### **Expressway Construction Progress**

Another article in the series on American cities. Projects in New York City, Pittsburgh, San Antonio, Chicago, other places, to be reported soon

#### **Highway Officials Meeting**

We'll report the annual convention, held this month at Salt Lake; and also the APWA Boston meeting in October

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A magazine devoted to the design, construction, maintenance and operation of highways, streets, bridges, bridge foundations and grade separations, and to the construction and maintenance of airports.

#### Gillette Publishing Company Publication and Editorial Offices, 22 West Maple Street, Chicago 10, III.

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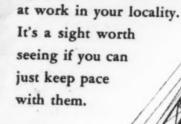
HAROLD J. McKEEVER, Editor C. T. MURRAY, Managing Editor H. K. GLIDDEN, Contributing Editor H. M. MAXWELL, Field Editor COL. V. J. BROWN, Consulting Editor

## IT'S BUILT TO KEEP BUSY!

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THE Lorain TL-20 Moto-Crane is built for a single purpose—to keep working all the time. Traveling on a rubber-tire mounting, this unit writes its own transportation ticket between jobs at speeds up to 30 M.P.H. And what if each job does pose a different material handling problem? With interchangeable boom equipment, this "versatile specialist" can vary its attack as a shovel, crane, clamshell, dragline or hoe.

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Your Northwests are real Rock Shovels—built for the hardest job a shovel has to do. The Northwest Dual Independent Crowd utilizes force other shovels waste. The Northwest Welded Boom, with Northwest Welded Dipper Sticks have been proved in nock diggins.



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More work, on more jobs, more days in the year mean low-cost, top notch performs TRAXCAVATORS are built in four sizes — for every job and purpose — with the rugged bucket canacities from 1/6 to 4 cubic vards. Each is a balanced unit with the bucket canacities from 1/6 to 4 cubic vards. TRAXCAVATORS are built in four sizes—for every job and purpose—with the rugged bucket capacities from ½ to 4 cubic yards. Each is a balanced unit with the rugged bucket capacities from ½ to 4 cubic yards. Learn now why it navs you to "Cateroillar" track-type tractor by which it is nowered. Learn now why it nave you to the results of t bucket capacities from ½ to 4 cubic yards. Each is a balanced unit with the rugged "Caterpillar" track-type tractor by which it is powered. Learn now why it pays direct traced by which it is powered. TRACKSON. "Caterpillar" dealer or write traced to the facts from your TRACKSON. "Caterpillar" dealer or write traced the facts from your traced to the facts from your

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Top Views: TRAXCAVATOR on Illinois sewer job clearing, grading and transporting concrete pipe Lower Right: Grading and leveling around new home Lower Left: IT4 TRAXCAVATOR digging a house basement











ORIGINAL TRACTOR EXCAVATOR



# NEVER TOO OLD TO EARN

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Glimpse of thirty-five million dollars' worth of new factory—by "Caterpillar."



Don't write off your old "Caterpillar" Diesels or sell them short. There are thousands that have looked worse, perhaps endured more—yet they have been restored and continue to make money for their owners.

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The new "boss" of earthmoving is the International TD-24 Diesel Crawler. This mighty prime mover delivers 140 horsepower at the drawbar—puts that horsepower to work boiling up heaping loads into big scrapers in a hurry! It lugs those loads to the fill fast!

Rugged terrain and tough working conditions don't stop the TD-24. Perfectly balanced weight and power, ease of handling, efficient all-gear drive plus planet-power steering make it stand up and perform like the leader it is. That means more work capacity—more profits in your pocket.

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Employ the leader—the International TD-24—and support it with other International-powered equipment. Make it the heart of your program for pay dirt.

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## Why TOURNADOZER

- ✓ gets more work done . . .
- ✓ makes more money for YOU!



- "C" Tournadozer gives you double aver-FASTER CYCLES age crawler dozing speed forward faster. You use higher gear speeds through instant speed Saves 10 seconds every time you shift.

AROUND JOB 15 mph — Means more jobs done, less non productive dozer time. One Tournadozer can clean up around 2 or 3 shovels, also maintain roads and service dump. A half mile is only two minutes away.



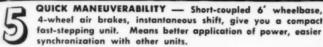
180 HP PUSH OR PULL - Hangs on and pulls under heavy load . . . low compression ratio diesel . . . more power with less fuel. 4-wheel drive . . . quick pick-up for fast get-away . , climbs steep grades.



INSTANT GEAR SELECTION — Change gear ratio instantly, automatically, with finger-tip air-valve lever. Constant power retains momentum . . . keeps dirt rolling. Travels 100' in 3rd gear, forward or reverse, while crawler shifts gears.



R. G. LeTOURNEAU, Inc., Peoria, III.: Please send information on "C" Tournadozer ☐ Specifications COMPANY TYPE of WORK for TOURNADOZER ...





BIG BOWL CAPACITY — 11'2" blade with bowl 3'7" high fills fast, drifts a big 2½ yard load. Rolls dirt easily, holds well on sides for big pay loads. Blade quickly tilted to cut in on side hill or ditch.



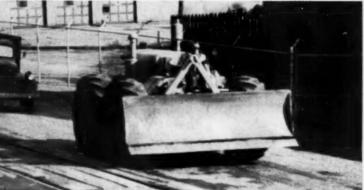
FAST BLADE ACTION — New, powerful, air-actuated PCU plus improved blade bite gives faster, better controlled blade to match high dozing speed. 44" lift . . . unlimited drop. Smooth, accurate, short-coupled cable-control.



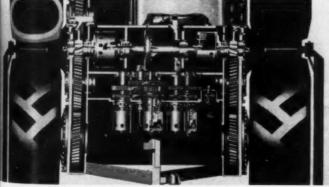
FULL OPERATOR VISIBILITY — Operator sits up front ahead of engine, can see where he's going . . . what he's doing. Easier to line up for pushing . . . work over a bank . . . safer to clean up under shovel dipper.



FASY TO OPERATE — Compressed air takes the work out of Tournadozing. Simple controls are air-actuated . . . easy to reach . . . easy to operate. No stretching, no twisting, no fatigue slow-down.



TRAVELS ANYWHERE — Makes self-powered moves over macadam, pavement or black top . . . crosses curbs, rails or driveways without planking. Works in plant yards, shop or factory with no damage to surfacing.



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TOURNADOZERS

IT'S RUBBER THAT PUTS THE ACTION IN TRACTION



Phelps-Wunderlich-James add fleet of LaPlant-Choate Motor Scrapers for 16,000,000 cu. yd. earthmoving job.

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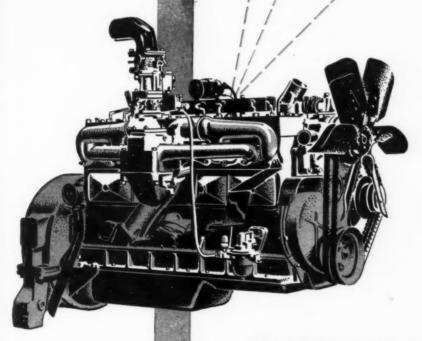
HIGH SPEED EARTHMOVING EQUIPMENT

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ON THE HIGHWAYS ON FARMS - IN OIL FIELDS - IN FORESTS - AND IN INDUSTRY!



• On tomorrow's highways, roads, streets and airports—wherever construction stretches past the horizon to a better world—Chrysler Industrial Engines and Power Units are on the job. They offer rugged power for shoveling or leveling . . . smooth, economical power for pumping or pressure . . . dependable power for tight day and night schedules. And, behind each Chrysler Industrial Engine stands the engineering and production skill of Chrysler Corporation—your assurance of a better product that's built For A Better Day's Work.

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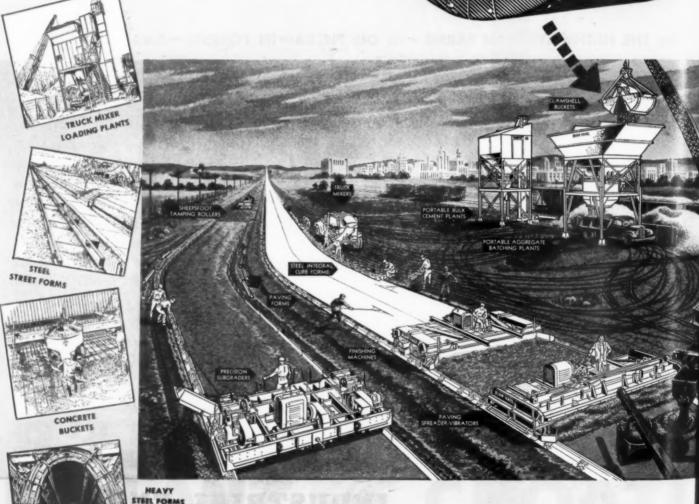
Today, with such efficient roadbuilding machines as Blaw-Knox Precision Subgraders, Paving Spreader-Vibrators and Finishing Machines, it's the Clamshell Bucket that "starts the ball rolling."

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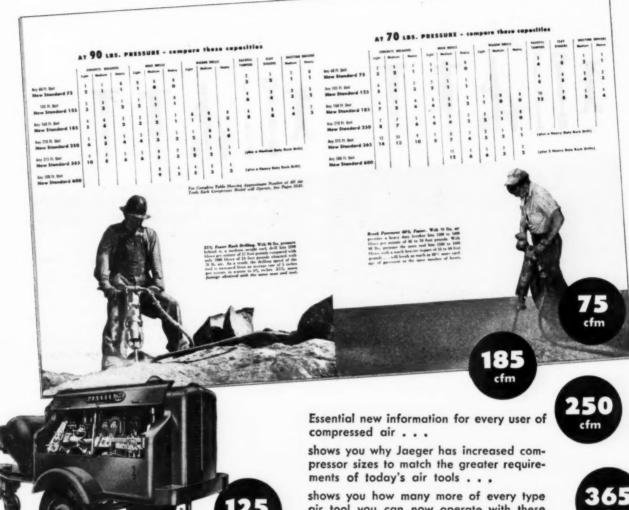




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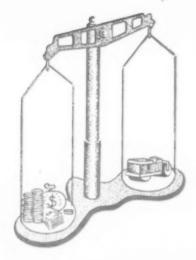
shows you why "full pressure" operation results in 30% to 40% more work with the same men and tools . . .

shows you the complete new line of Jaeger "AIR PLUS" Portable and Stationary Compressors now available at no increase in price for their extra capacity.

See your Jaeger distributor or send for this new buyer's guide today. Specify Catalog JC-8. THE JAEGER MACHINE CO., Columbus 16, Ohio.

## engineered equipment

COMPRESSORS 4. DIAGONAL SCREED FINISHERS. SCREW SPREADERS . BITUMINOUS PAVERS



## the Balance

## IS IN YOUR FAVOR WITH MODERN



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Huber's versatile Road Maintainer—a lift loader, berm leveler, bulldozer, patch roller, snow plow, or rotary broom all in one.

Today's conditions demand that your operation's budget balance out. Modern Huber road machinery will help you do better than that—the efficient, result-producing Huber line will actually tip the balance in your favor.

Road men, from maintenance crews to new road contractors recognize the "extras" that are built into every piece of Huber equipment. Plenty of power...economical operation...dependable performance... and the ability to do any job are Huber traits that point to more profitable road operations for you. Write today for bulletins on the Huber equipment that will best serve you.



Huber's always dependable 3-Wheel Rollers—built in sizes, from 5 to 12 tons, suited to any relling operation.



Huber's highly manueverable Tandem Rollers lend themselves to many special tasks. Variable weight models from 3 to 14 tons.

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MFG.COMPANY . MARION, OHIO, U. S. A.

HUBER ROAD ROLLERS MAINTAINERS



Outstanding production records are an old story to Bucyrus-Erie excavators, which have consistently piled up long hours of operation with low maintenance costs. Take this Bucyrus-Erie 30-B dragline, for instance. Here is part of a letter received from Mr. J. G. MacLachlan, manager of the Hudson Bay Railway, Manitoba, Canada:

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r, 1948

There is no magic formula for the long life of Bucyrus-Eries. Durable parts in an efficient basic design; easily-made, long-lasting adjustments; simple, effective lubrication — all these play an important part in keeping Bucyrus-Eries on the job year in, year out, with a minimum of "time out" for repairs and with consistently economical operation.

Your Bucyrus-Erie distributor can show you why today's Bucyrus-Erie 3/8 to 2 1/2 -cu. yd. excavators can be depended upon for long service and still be "easy on the upkeep." Let him give you more information.

BUCYRUS-ERIE CO. SOUTH MILWAUKEE, WISCONSIN

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Ceco's pre-bidding data takes the guess-work out of bidding, so you can bid to get the job—make money on it, too.

2. Ceco's material data lets you forget detail work—you are supplied with blue prints on reinforcing and other materials, making the job much easier.



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GENERAL OFFICES: 5601 West 26th Street, Chicago 50, Illinois

CECO

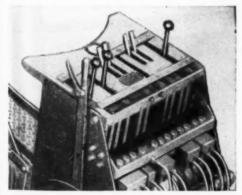
TYPICAL CECO HIGHWAY PRODUCTS • Welded Wire Fabric • Metal Center Strips Cecure Curing Compound • Reinforcing Steel • Load Transfer Devices • Joint Sealing Compound Dowel Bar Supports and Sockets • Stake Pins • Expansion Joints • Sub-Grade Paper

In construction products CECO ENGINEERING makes the big difference

## LINK-BELT Speeder

# EASIER TO HANDLE CRAWLS AND TURNS BETTER





### SPEED-O-MATIC CONTROL

"Speed-O-Matic" hydraulic control permanently eliminates all "lost motion"— actuates clutches faster and more smoothly. Operators will tell you the "Speed-O-Matic" control relieves manual effort and there is little or no fatigue after a good day's work. Get the facts today — find out how you, too, can greatly increase your output.

r, 1948

## **MORE SPEED** for more profitable operation

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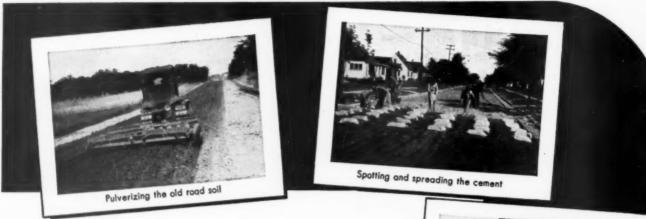
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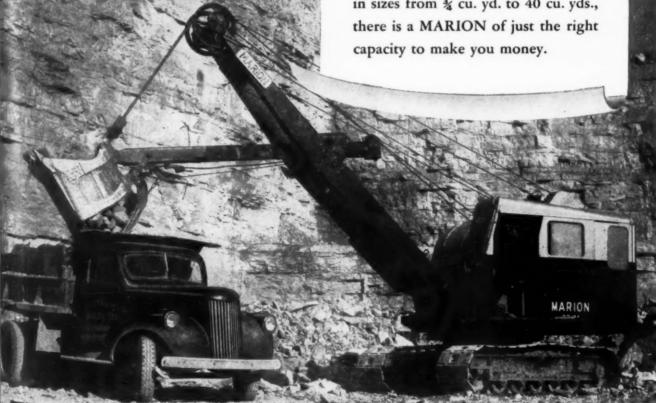


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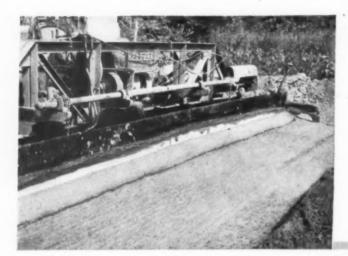
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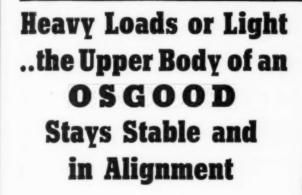
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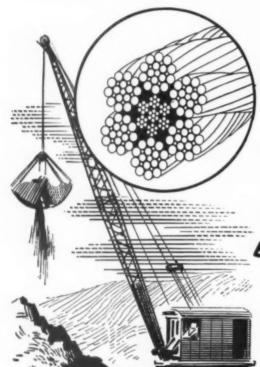
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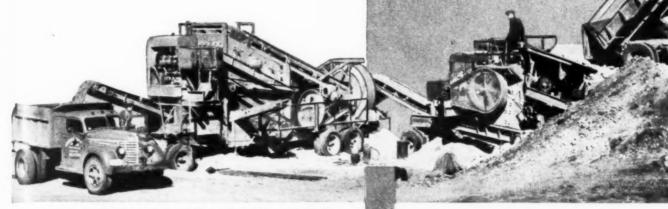
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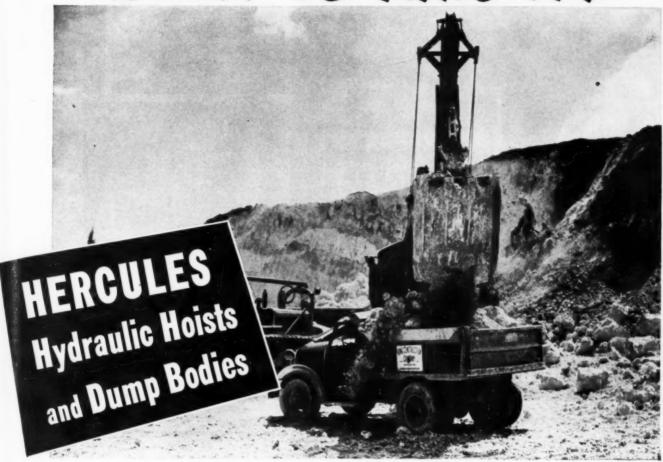
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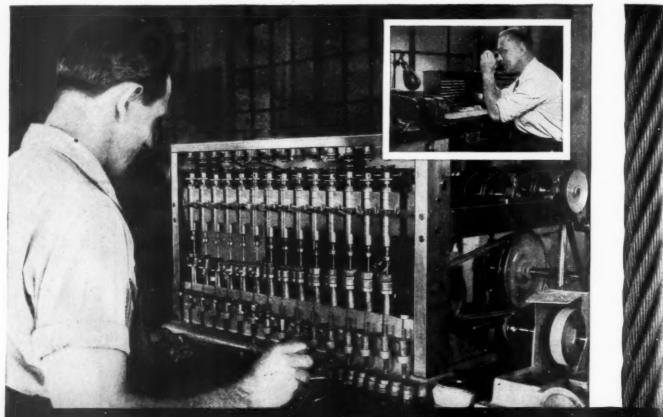
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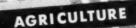
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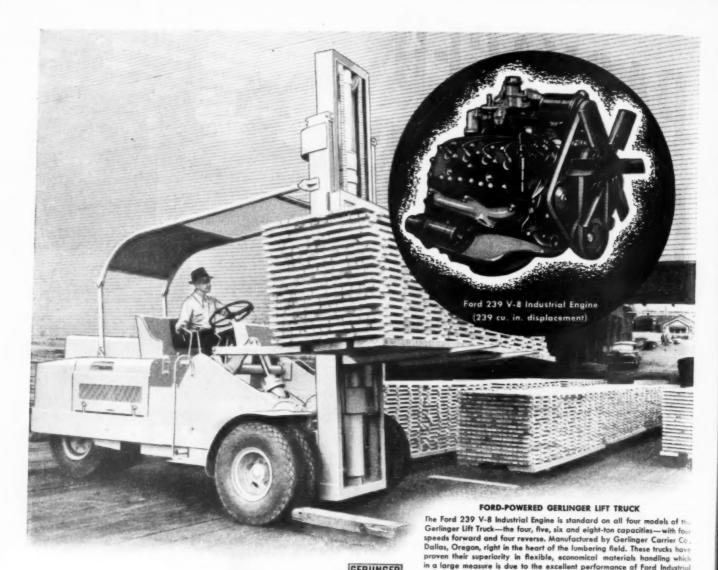


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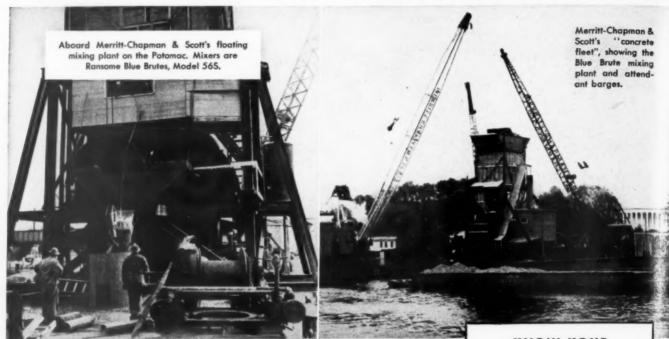
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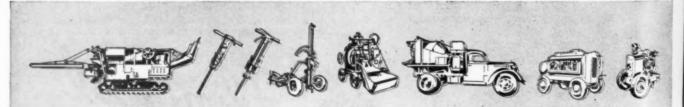
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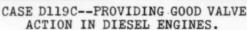
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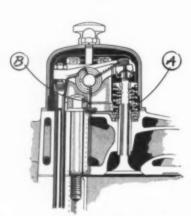
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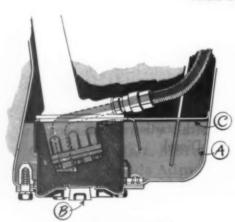
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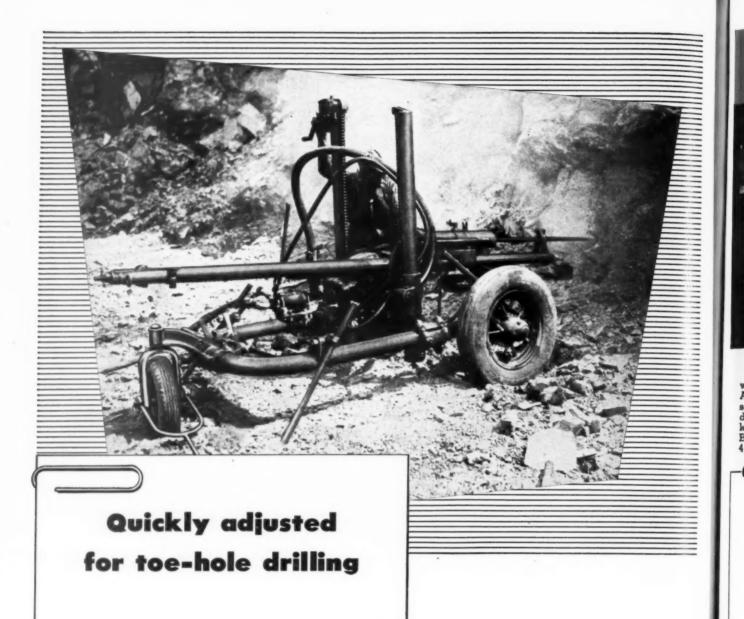
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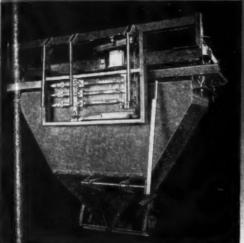
The G-200R Wagon Drill is available with CP-50N (3"), CP-60N (3½") or CP-70 (4") Drifters. Write for complete data.



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New housing ranks foremost among the nation's urgent needs. Clearing the way for thousands of dwelling units now under construction are fleets of hard-working Mack dump trucks — today, as in the past, top favorites with cost-conscious contractors.

The Mack Model LJ six-wheeler shown here is one of a busy fleet operated by D'Aquila Bros. of New York, contractors for excavation, foundation and fill on one of the city's huge housing projects.

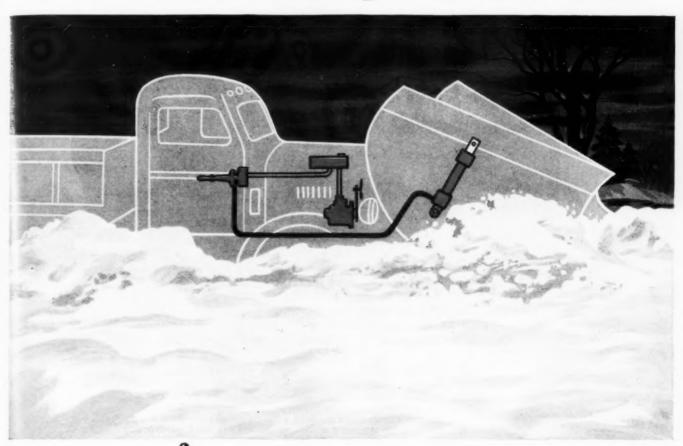
Long-lasting Mack stamina and economy have proved profitable for D'Aquila Bros. over long periods of time. Several Macks in their fleet are still putting in a good day's work after 19 years of service.

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Tractors used 1/2 the year cost twice as much to own as tractors used all year 'round.

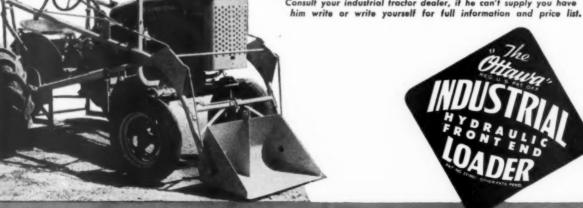
There is an Ottawa loader designed for use with light industrial tractors such as the International A and Case V A I illustrated here. These loaders have been approved by Industrial Engineers of leading tractor manufacturers.

These Ottawa Loaders and their attachments have enabled State highway departments and other light industrial tractor owners to cut light tractor operation costs over ½. Keep your tractors working all year 'round. Here are some of the jobs the Ottawa Hydraulic Front End Loader will make it possible for your light tractors to do when they would normally be idle.

- Load trucks with cinders, sand or salt for treatment of icy streets or highways.
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ROADS

# **ROADS AND STREETS**

SEPTEMBER, 1948 ● VOL. 91 • No. 9

# **Bituminous Paver Mixes and Spreads**

# **Emulsion Base**

First use of this combination in New York state tried on 14mile secondary road project

M ANY miles of New York state's secondary roads are long overdue for modernization, and the department of public works is seeking means of fixing up the more urgent sections at reasonable per-mile cost. One of the more interesting projects for 1948 was the widening and resurfacing of state route 41, along the east side of Skaneateles Lake in Onondaga County.

This road is a favorite of vacationists in the Finger Lake region, and more recently has been used heavily by coal, oil and gasoline trucks. A typical winding hill-road, its old stone roadbed dates back to 1908. While the road had been surface treated every few years, nothing much had been done about the increasingly wavy riding quality.

In checking over this road the state's highway engineers decided that complete reconstruction, including straightening, cutting down the hills and re-cross-sectioning, would not be justifiable, especially at today's inflated costs. An economy job was set up which involved widening the 16 to 18 ft. roadbed to 20 ft. with rolled gravel, widening shoulders to a 4 ft. minimum, and applying a 2½-in. bituminous retread binder course and a 1-in. plant mix top course.

## **Emulsion for Binder**

Road-mixed crushed stone and emulsified asphalt were specified for 2½-in. min. thickness of binder course, and hot plant mixed asphaltic concrete machine laid for the 1-in: surface seal coat.

Widening was done by blading trenches, dumping and spreading pitrun gravel and rolling the gravel in two layers.

Warlock Stone Co., of N. Tonawanda, N.Y., took the job and elected to use a moto-paver in preference to the option of blade graders, as a means of minimizing traffic interference during one-lane placement and assuring uniformity of mix and surface trueness. A new Hetherington & Berner moto-payer plant was brought in for the binder course and the first 5 miles of the 14 mile project processed with windrowed stone. A mechanical loader, attached to the front end of the plant, picked up the material. But the contractor changed to direct truck delivery to the paver hopper for the remainder of



\* A 20-ft. leveling bar on either side aided the travel plant in leveling the wavy old road. Bitumuls used in the emulsion mix

948

# **Western ASHO Meeting**

HIGHLIGHTING the convention of the Western Association of State Highway Officials held July 25 through the 28th, at Portland, Oregon, was an address by A. C. Clark, Chief, Construction Division, Public Roads Administration, on the need for an adequate system of secondary roads. Approximately 250 delegates were registered from the 12 Western States, Hawaii and Alaska.

Mr. Clark pointed out that 27,000 miles of the federal aid system were damaged beyond economical repair due to the abnormally heavy traffic developed during the war. To this problem has been added the increments of obsolete mileage that need modernization, relief for traffic congestion in urban areas, and the need for an integrated system of farm-tomarket roads.

#### **High Cost Secondaries**

These same thoughts were also statistically presented to the convention by Dr. L. I. Hewes, Chief, Western Headquarters, Public Roads Administration, who also stated that about 20%, or 600,000 miles of approximately 3,000,000 miles of rural roads should be abandoned. Dr. Hewes also brought out that secondary federal roads in the West cost an average of \$21,941 per mile.

During his address, Mr. Clark stated that the urban program was lagging. It was this lag, as brought out by other speakers, that was responsible for the narrow escape the last federal aid bill had in the closing days of the last Congress. To have the work contracted was not suffcient. Congressmen require that the money be spent, so the convention was advised by D. C. Greer, state highway engineer of Texas, to spend all appropriations between now and the next time federal aid funds are to be requested, which is two years from now. He advised that highway

The aggregates used for this course

consisted of 220 lb. of crushed stone

in two sizes combined to meet an

"open" specification, 100% passing a

the job. The problem of drying out windrows after rains was a factor in the change, as also was the occasional difficulty of the loader in cleaning up all windrowed material where heavy swells or dips occurred in the old road surfacing. Normally this type loader would have worked very well, but this road was suffering from such

an extreme case of waviness that the fic compaction.

engineers for a time considered specifying a bladed wedge course as a preliminary measure. As it was, a fine road has been secured without the expense of scarifying and reshaping the old roadbed and thus destroying the stability created by long traf-

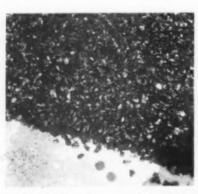
11/2-in. square opening, 90-100 passing a 1-in., 15-20% passing the 1/2-in. and not more than 3% passing the ¼-in. opening. Approximately 1.4 gal. of emulsion (volumetric mix) was used per square yard. A normal of 4,000 lin. ft. of 10-ft. strip was placed per day. Traffic interruption was also a factor in the use of fewer and larger stone delivery trucks, which were of various makes and sizes with bed capacity up to 12 tons.

Two 10-ton rollers compacted the mix, rolling being delayed sometimes for two days while the mix was setting, depending on the weather conditions. The 1-in. hot-mix top was placed with an Adnun paver.

Kenneth Johnson was the contractor's superintendent and W. J. Bell was project engineer on this job. which was let under the department of public works Syracuse district, Wm. Robinson, district engineer.



\* Ahead of paving operations a Gradall performed various shoulder trimming and clean-up work. Here shown picking up stockpiled stone, dumped the previous week during an emergency







★ (Left): How the open mix for the leveling course looked, immediately after mixing with emulsion and spreading. Note even, thorough coating. (Center): Superintendent Johnson and project engineer W. J. Bell, with D. K. Howe sales manager, Harrod Equipment Co. of Syracuse, N. Y. (Right): Big-capacity truck for stone delivery, and hence use of fewer trucks, helped reduce traffic interference

ROADS AND STREETS, September, 1948

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Reviewing postwar highway work and the needs therefor, Mr. Clark stated that shortages of materials and equipment acted as a brake against ary impulse to throw public funds in o competition for critical materials to the detriment of other essential improvements. He reported that highway costs are now 26.9% above the 1946 base, and 110.7% over the 1940 index. He further brought out that rejections of bids for highway projects declined from 21.4% in 1946 to 11.4% in the first six months of 1948. This fact indicates that engineers are becoming more cognizant of the inflation and the difficulties that beset contractors when an unstable labor and materials market faces them. In order for contractors to develop efficiency in their organization and in order that they may be willing to invest the large sums required in these times for newer and more modern equipment, they must be assured of a continuing program of work, a long range program. With Congress requiring the states to be broke before they will look favorably upon a new federal aid program, the contractor is faced with the proposition of a \$500,000,000 program in sight and then possibly, or probably, no more.

This condition is a very potent factor in high contract prices. A consensus of opinion amongst some contractors attending the convention is that prices are expected to rise. They have been successful, through organizational efficiency and newer, larger equipment, in lowering the costs of excavation; also, it may be said, that paving prices, both portland cement concrete and bituminous, have gone down. But in view of the recent Supreme Court decision on the basing point system for freight rates, there seemed to be common belief that this decision would adversely affect paving and construction prices.

G. Donald Kennedy, vice-president, Automotive Safety Foundation, discussed "Long Range Highway Planning in Washington and Oregon" on which his organization and the states are cooperating. He explained the mechanics of the preparation of a report. Considerable work yet remains to be done before the report is ready for publication.

In his annual message, as President of the Western Association of State Highway Officials, Tom W. Holman, Chairman, Washington Advisory Commission, stated that the cut in highway appropriations was a challenge to produce results. His address covered four important thoughts:

1. He developed an argument for abandoning the present terminology of "gasoline tax" for fund-raising and substituting therefor thinking in terminology of "utility rate." He favored outlawing the label "tax."

2. Sniping from the back or from within must be eliminated. In developing this topic he cited how selfish elements were grasping for gain, and also how other groups who benefit by highway development undermined the efforts of engineers for adequate highway legislation. While no names were mentioned by Mr. Holman, it was learned from competent authority that the American Motorists Association, the American Trucking Association, and the American Farm Bureau opposed the recent federal aid bill. Furthermore, the Highway Users' Conference was conspicuous by its absence in favor of the bill.

3. A strong public relations program was urged to close the gap between the public and their ignorance of the highway problem. Public relations properly is a public function and should be employed to keep the public informed.

4. Recommendations Mr. Holman made to the convention are:

a. Establish public relations programs.

b. Provide emergency funds.

c. Establish uniformity of motor vehicle regulations.

d. Cooperate with airport agencies to provide airport highway service.

Richard E. Dougherty, President, American Society of Civil Engineers, and long connected with the railroad industry, discussed "Transportation in General." He recommended a separate Commission on Coordination of Transportation and stated that all transportation for hire should be self-liquidating. He favors the issuance of a certificate of convenience and necessity for transportation for hire.

The paper presented by Fred Wolf, Washington State Highway Advisory Commission, and discussed by Roy McLeese, Chief engineer, State Road Commission of Utah, also discussed from the floor. The various comments all cited the need for establishment of a continuing public relations program. All put together, however, saw only the press, radio, and maintenance men angles. When a public relations program is initiated, a state would be well advised to employ an experienced, fulltime public relations director with authority to act and a budget under his control. This writer thoroughly disagrees with the thought presented by Dr. Hewes that public relations could be handled as a part-time job of some other employee of the state highway department.

Roads or Bridges

On the subject of "Highway versus Bridge Priority," Fred Panhorst, assistant state highway engineer and bridge engineer, California Division of Highways, posed the problem so often encountered as follows:

If the department had only a certain amount of money to spend on a project, and the bridge on the project would take it all, which should be built, the bridge or the highway? In the paper he answered the question by stating California's procedure, which is to present the data and facts to a board of engineers within the department, and let their decision be a recommendation to the commission.

Due to the shortage of time, N. M. Finkbiner, materials engineer for Oregon, explained experimental work done by the highway department on "Beam Type Guard Rails." He developed a proposed specification and recommended that the Public Roads Administration do some research work on this subject for the benefit of all of the states.

New officers elected for the ensuing years are: President, W. C. Lefebvre, State Highway Engineer, Arizona; Vice President, W. T. Holcomb, State Highway Engineer, Nevada; Sec.-Treas., W. C. Williams, First Asst. State Highway Engineer, Oregon State Highway Dept.

# Connecticut Wins Top Traffic Safety Award

Recent announcement of winners of the 1947 National Traffic Safety Contest conducted by the National Safety Council revealed Connecticut received the grand award for states. This is the second consecutive award for Connecticut. Commenting upon the award in an interview published in Public Safety, William M. Greene, Director of the Connecticut Highway Safety Commission, said: "Connecticut keeps everlastingly at it (reducing traffic accident severity) . . . Every effort is made to keep communities alive to local responsibilities . . ." Significant factor in Connecticut's success is the time devoted to traffic engineering investigations and surveys. Connecticut's mileage death rate has dropped consistently, from 7.4 in 1944 to 4.3 in 1947. All 48 states and 622 cities took part in the contest. Oklahoma City, Okla., and Wilmington, Del., tied for the grand award among cities.

# \* Should Contractors Be Given Head?

"One way to help bring highway construction costs down is to specify more end results and less methods." is the gist of contractor association thinking today. We have seen several variations on this theme in print recently, over the name of a prominent contractor or association leader. And a good many engineers feel that in general this is sound thinking. Particularly on grading of large road projects, airfields, and other jobs, the business of getting required compaction is a variable one in which the contractor (if he has a good engineer or is one himself) can often devise safe short-cut methods. Why roll eight passes with a sheepsfoot if the equipment, skillfully routed, practically brings density up to requirements? What about vibratory rollers? The effect of the big new rubber-tired bulldozers on the grade? Why cannot big 50 to 200 ton super compactors be tried in more different states on road work, if the contractor so desires and the material is right?

Yes, the contractor ought to be given all the head he shows the ability to use. But here and there, all through this past summer, this editor has seen contractors busy spoiling the case for their fellow members. One we could name made trouble all along the line. Another, with an organization principal acting as superintendent, just plain didn't have the ability to make a job roll. Still another, apparently in an effort to break yardage records with the 34-E's, put down a roughriding concrete pavement his whole state is talking about. (Paving, by the way, is a field where inspectors need a procedure specification all the way through, and in this particular case the array of modern finishing

equipment was said to be too heavy for the forms.)

The point is, some contractors need policing every minute of the day, and a gyppo or an outfit with a green saperintendent can't be made to turn in a first-class job with any number of experienced (find them) inspectors and resident engineers breathing down their necks. The contractor can tear out lenses of poorly compacted grade, and often does, with no great harm, but we've yet to see anyone tear up several miles of poor quality pavement. So, for now, it looks like the "end results" type of specification will have to come along slowly. On grading, perhaps faster. On paying, someday, maybe. Meanwhile, the contractor groups, which have already done a fine job in many states, will have to try even harder to instill the quality idea into the small percentage of their members who make trouble.

# \* Truck Economics Studies

It would be hard to imagine a more important subject for highway researchers to tackle than the economics of traffic use of the road, particularly of truck transportation where dollars mean business. Everyone will certainly watch with keen interest the progress and studies being launched in Penn-

sylvania by the Highway Research Board in cooperation with various interested agencies.

This effort makes us think of A. M. Wellington, the famous editor and textbook writer of the 1880's, and the debt that railroad transportation owes him for his pioneer effort in clarifying

engineering knowledge of railroad transportation in relation to roadbed design. A highway, no less than a railroad, is not just a physical plant, but a living thing which is either an asset or a liability, according to the degree in which it helps or fails to bring about the safe, efficient flow of traffic.

# \* Parking Meters Not for Revenue

Parking meters should not be used except where they will contribute to the easing of congestion and the solution of a parking problem. The tendency of cities to install meters as a means of augmenting the municipal income is to be regretted.

An example of the money point of

view in parking meter thinking is shown in a recent news item in a Boston newspaper. Traffic Commissioner Leo F. Curley, in this news report, is quoted that a large number of the city's 2500 meters had been made inaccessible to motorists by construction work going on in three local areas

over the city. As a result, cash collections from meters fell from \$1100 down to \$880 per day. The further statement was made that 500 new meters were about to be installed. The report was unfortunate in that it dwelt on the money side of meter installation, saying nothing of their constructive results, if any.

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# \* The Engineering Approach To Traffic Safety

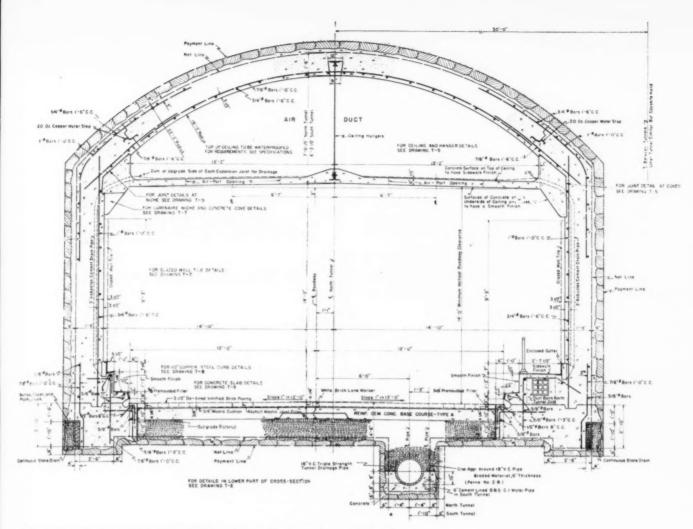
The traffic safety problem was neatly summarized early this year by Donald S. Berry of the National Safety Council. His thoughts, given at the last Purdue Road Schools, are repro-

duced here for all to read as a reminder that safety progress is impossible without a broad, united engineering program. Mr. Berry said:

Because of their background and

training in the factual approach to all problems, engineers can and should contribute a lot to a coordinating approach to traffic safety. For maximum

(Continued on page 70)



\* Cross-section details of Squirrel Hill Tunnel, Penn-Lincoln Parkway, Pittsburgh

# **Big Tunnel Job**

# Pittsburgh's Squirrel Hill project—the largest current contract in nation's highway program

THE Pennsylvania Department of Highways, with PRA approval, has awarded the contract for construction of the Squirrel Hill Tunnel in Pittsburgh, which will be part of the Penn-Lincoln Park. B. Perini & Sons, Inc., of Framingham, Massachusetts, was awarded the job at \$13,767,843 low bid. The other bid submitted July 23, by the Hunkin Conkey Co., of Cleveland, was \$14,-611,375.

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Bids for the project were originally received in March and two contractors submitted proposals, the lower being from Hunkin Conkey Construction Co., \$17,824,147. This bid was rejected as excessive and plans were revised to eliminate some of the items which could not be

started until after the tunnels were

The project now includes all of the work except the tile lining for the twin tubes, the brick road surface in the tubes, construction of the ventilating building above the electrical floor, and the paving of the approaches.

The contractor has two years, and when tunnel construction nears completion, bids will be asked for the items eliminated.

Work covered in the project includes 247,450 cu. yd. of excavation for the rock tunnel and 89,904 cu. yd. of other excavation. The twin tubes will require 7,761,000 lb. of steel for the permanent tunnel supports, 5,273,000 lb. of steel bars and

88,560 cu. yd. of concrete.

The twin vehicular tubes alone will take 102,400 cu. yd. of concrete, 21,350 sq. yd. of brick pavement and 33,800 sq. yd. of concrete approach paving. The project also will require 6,000,000 lb. of steel reinforcing bars and 2,378,000 lb. of structural steel.

# **Coming Meetings**

Highway Research Board, annual convention; Washington, D.C.; Dec. 6-10.

Associated Equipment Distributors, annual convention; Chicago; Stevens Hotel; Jan. 16-20.

National Crushed Stone Assn., 32nd annual convention; New York; Hotel New Yorker; Feb. 7-9.

National Ready Mixed Concrete Assn., 19th annual convention; New York; Hotel New Yorker; Feb. 14-18.

National Sand and Gravel Assn., 33rd annual convention; New York; Hotel New Yorker; Feb. 14-18.

# Progress in Expressway Construction in American Cities

2-LOS ANGELES

# Four-Level Super "Crossroads"

# **Embodies Novel Structural Features**

- Main structure of 13-bridge interchange system includes 3 bridge decks, supported on 10 U-abutments and 73 columns with independent footings
- One of a score of structures recently completed or in progress in state's urban expressway program for Los Angeles

MOST publicized of the many grade separation structures being built or planned for Los Angeles is the four-level interchange located where the two main urban expressway axes cross. The Hollywood-Santa Ana Parkway axis crosses over the Arroyo Seco-Harbor parkway axis at a point near downtown Los Angeles. The extremely large traffic concentrations anticipated [R&S Sept. '46] plus the need to conserve space, resulted in a novel interchange design, depicted in the accompanying photographic reproduction of a model. An account of the advance soils studies of the site was presented in Sept. '47 R&S.

The Sunset Boulevard overcrossing in this 13-bridge system was completed early in 1948. This concrete box girder bridge involved no unusual features. The Temple Street overcrossing, now under construction by

J. I. Barnes Construction Co., of Los Angeles, while somewhat unusual in deck plan, is of conventional rigidframe design. Technical interest centers on the main structure, which was awarded in June, 1947, to the Barnes organization under a separate contract, involving \$1,300,000. This project is well under way, and scheduled for completion March, 1949. The accompanying notes and photos serve to explain the main design features, which are the result of several years of preliminary soils investigations and traffic and structural studies by the highway staff. Exceptionally detailed working plans include 66 design sheets, 45 sheets being required for the structure alone.

As seen at a glance, the structure consists of a pair of 3-lane express roadways crossing over a 6-lane divided express roadway, with two pairs of ramp roadways also passing through the structure at two additional levels.

The lower roadway consists of a pair of interchange roadways at grade, slightly depressed below the original ground level. This roadway comprises a standard sub-base, base and concrete pavement cross-section, with necessary surface drainage.

The second deck, a 6-lane divided roadway carrying Harbor-Arroyo Seco Parkway, is made up of continuous slabs supported on a somewhat irregular column arrangement, usually including three columns to a bent.

The third deck comprises two ramp roadways of reinforced concrete box girder design, each supported on single-column bents.

The fourth or upper level includes two parallel bridges of continuous concrete box girder design, carrying the two 3-lane roadways of the Hollywood-Santa Ana expressway.

# Unique Column Pattern

From the beginning, in developing the general design and the structural details, a major problem was that of supporting one deck above another while providing roadway clearance.

Columns are all circular in section with vertical form marks, giving a pleasing fluted effect. Considerable attention has been paid by the Contractor to form design and, as a result, re-use of forms has been in-



★ Birds-eye view of the ultimate development. Roadway at right is Sunset Blvd., looking toward Hollywood from downtown Los Angeles. This arterial will be relieved by Hollywood Parkway (high-level twin roadways) which will follow a roughly parallel route

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Columns are of 3-ft., 4-ft. and 4½-ft. diameter, with standard reinforcement. The percentage of vertical reinforcement varies from 1.5% to 4.2% of the core area, thus aiding in keeping the column sizes to the three sizes under varied loads.

Rising full height through the structure is a 4 1/2 -ft. diameter center column which is 62 ft. high. This column is supported by a 26-ft. ribbed, hexagonal footing and is fixed to each of the three decks which it supports. There are several other columns wlich rise through one or more intermediate deck slabs and which support these decks by means of cast steel rings designed to make the column and the deck slab through which it passes structurally independent of each other under lateral forces. The rings are anchored into the surrounding slabs by welded anchor bars (see Fig.) and free sliding is insured by a seating of 2 layers of graphited asbestos sheet packing. This type of seating has been used successfully in California bridge structures for several years.

Also part of the structural scheme is the use of hinged construction at the base and/or top of certain columns. This hinge action is effected by converging the vertical reinforcement and dowels at hinge points, the columns not being tapered but the cylindrical design continued to the end of the column. Rotation of the column is permitted by placing a layer of expansion material in the outer part of the joint (see Fig.).

★ Funny place for a bench mark? Why not!

★ H. R. Hineman, resident engineer on the Sunset crossing structure; J. G. Green, bridge department representative in Los Angeles area; H. R. Lendecke, resident engineer on the 4-level project



★ Sunset Boulevard bridge overpassing Arroyo Seco was built first. Shoofly at right, which carried extremely heavy traffic including electric railway, is being torn up

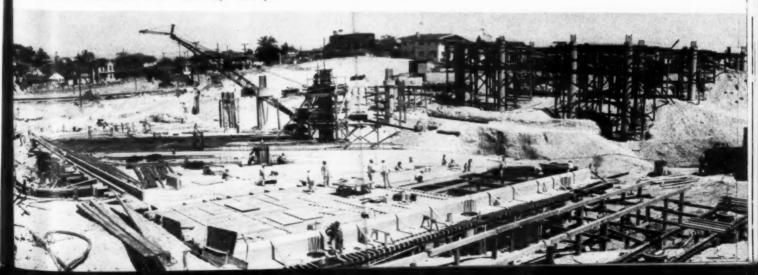


★ Utility installation could not wait on removal of Sunset detour pavement. Shown here is an Emsco pavement breaker with knife-shaped cutter, powered by 315 cfm. Sullivan compressor, working ahead of an Austin ditcher





★ How the job looked as of late April, 1948. Link Belt Speeder with 75-ft. boom and 20-ft. jib set concrete for entire job. Highest columns are for the top deck, which is for Hollywood Parkway (see artist's drawing). Deck under construction is for lower ramp roadways



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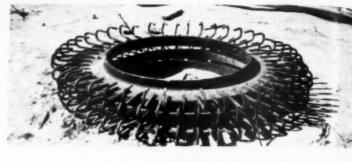
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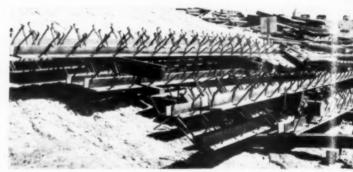
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★ (Above): Steel collar with welded anchor bars, for setting in deck slab around riser columns (Lower View): Anchor assemblies for reinforcing deck slabs over bridge seats

★ (Left): Column being concreted from 1-yd. bucket (Gar-Bro) using specially devised worker platform which fits around top of tremie pipe. Pipe and platform easily moved by crane, which also sets column reinforcing cages



★ A typical column footing, with steel set for hinged joint. Forms just removed

Another view showing lower ramp roadway deck (level No. 2), and columns partly poured for 3rd and 4th level decks. Note concrete collars on some columns, designed to support intermediate slabs



★ Separate contract but no small potatoes is J. I. Barnes' Temple Street rigid-frame overpass project adjacent to the "4-level" job. Truck-crane is a Browning, truck-mixer a Jaeger

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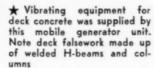


★ Ceiling lighting unit, anchored in place and ready for the deck pour

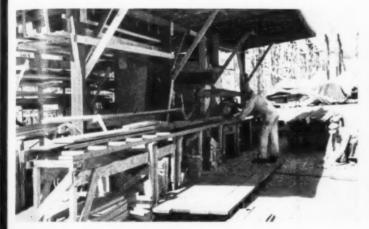




★ Finishing surface for lower ramps. Cotton mats were used for curing



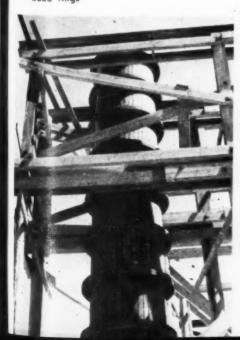






★ Views of the contractor's form fabricating shop, located alongside the project. Bench equipment included one band and three circle saws. Numerous hand-held power saws were employed in the shop and on the job

★ Wood "silo" construction was used for forms, with panels designed for reuse. Liner consisted of t. and g. stock (dressed 2 x 4's), held by ½ x 2 in. steel clamps and stiffened by laminated wood rings ★ 60 cu. yd. per hour batching plant for truck-mixer delivery, set up adjacent to the project by the Blue Diamond corporation. The four bins hold 30 cu. yd. each. Plant includes Kron manually operated scales, aggregate scales having a capacity of 10,000 lb. and cement scales 3,000 lb. Water is supplied from a 200-gal. tank to the 2-yd. batches







The details of column design were compiled into an elaborate table for convenience to both the engineers and the contractor.

## **Individual Footings**

All columns have individual footings, each designed in accordance with load tests and other available data, the unit footing pressures for each being varied under a carefully studied plan to insure uniform subsequent settlement.

In addition to the 26-ft. hexagon footing for the three-deck center column, five smaller footing sizes are employed, having maximum hexagon diameters of 22, 20, 17, 14 and 12 ft. Footings resting on undisturbed sandy shale are designed without piles. For other footings it was found more economical to go through filled ground with piles than to excavate full depth, and 10-in. 42-lb. or 12-in. 53-lb. H-piles ranging from 10 ft. to 40 ft. in length were used for these footings. Outer piles are battered 1 to 4.

The reinforcing steel cage for each footing was prefabricated and was placed as a unit by a crane. The footing forms were carefully designed for ease of placing and stripping.

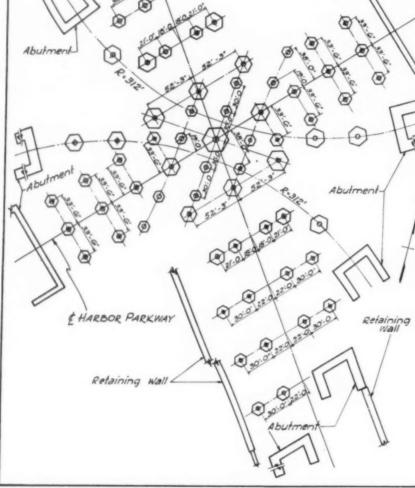
The U-abutments involve no unusual design features. As with the column footings, abutment footing areas were adjusted in accordance with field settlement tests to provide for a theoretically uniform subsequent settlement in service.

★ Showing reinforcing being assembled for deck slab and framing. 3,500,000 lb. of bar reinforcing required! Note welded collar in place around column "Plastiglaze" coating used on forms instead of usual form oil. Plywood form liners were used 3 or 4 times on job

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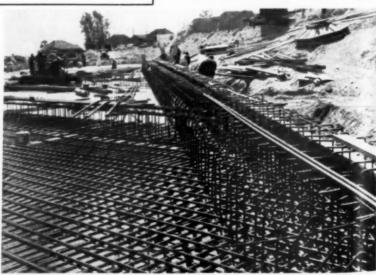
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ROADS AND STREETS, September, 1948



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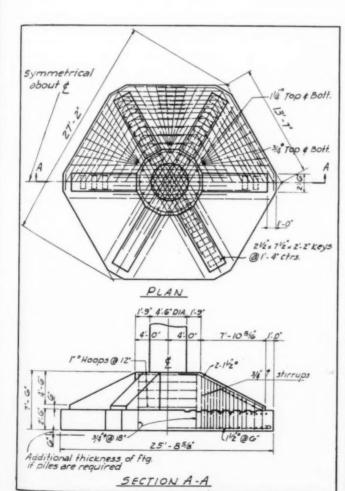
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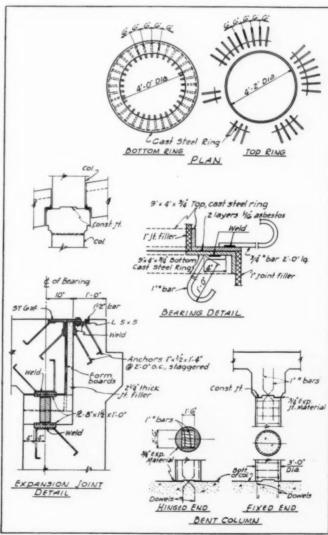
★ Sunset Blvd. structure, under which Arroyo Seco will eventually pass. Note fluted columns, created without rubbing by use of silo-type forms

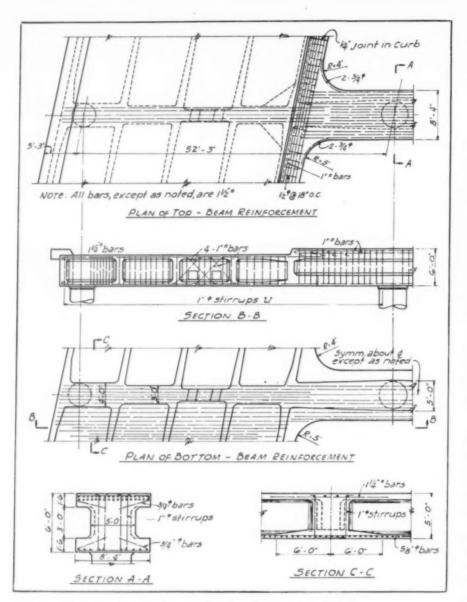
★ (Upper): Falsework for deck of rigid-frame Temple Street overpass. Arrows point to H-beams laid on sides as sleepers for struts. (Lower): Quonsets set up near job by the contractor for storage of lubricants and tools



 $\bigstar$  Details of largest footing. Smaller footings not counterforted but have beveled toes

★ Details of iron rings in intermediate slabs, where column rises through. Lower details show bridge seat reinforcing scheme and details of column hinge





★ Some of the details showing the unusual design of hollow concrete decks for parallel express roadways, joined by solid cross beams over columns

#### **Unusual Deck Details**

The irregular column spacings required for roadway clearance complicated the deck design. Typical details are shown in accompanying sketches and photographs. Special thought was given to details of reinforcing to tie slabs in with column supports, this phase being the subject of extensive design study.

The third level, consisting of a pair of ramp roadways, is of special interest, both in design and construction, because the slabs included almost every imaginable complication. The roadways each are on horizontal curves with transition to full superelevation, as well as on grades and vertical curves. As an aid in field location and in building the forms, detail sheets were furnished showing the elevations at base of curb, and the thickness and width of the deck slab, at frequent fixed intervals on a co-

ordinate layout system.

The top or fourth deck, consisting of two express roadways, is of hollowbox girder design. Design details are conventional except for two features. Heavy diagonal bars top and bottom are included to tie columns together. in addition to the usual transverse and longitudinal reinforcing. A special feature of design is the use of three heavy reinforced concrete caps, each supported by three columns, which carry the two center spans of both hollow-box decks and simultaneously tie the two decks together. Transition from hollow box to solid cap section required an unusual fanning out of transverse bars in the top and bottom slab of the box to insure integral design.

So complicated is the detailing of reinforcement for this deck, that a separate design sheet was considered necessary for the stirrups and their spacings. Ten design sheets were required for the complete deck slab.

Deck slabs are being cast in a sequence of sections designed to insure balanced deflection as the pouring progresses.

#### **Deck Details Tested**

Deck slab design details also were the subject of numerous extensive tests. Expansion details were given particular advance study. A typical expansion end includes a 1½" x 8" x 22" bearing plate in the abutment seat, a similar plate in the bottom of the slab, and rocker bars between. The slab ends and parapet ends at bridge seats are reinforced with heavy (1" x ½") anchor bars, bent and positioned as shown in accompanying sketch. Form boards are left in place as joint filler between slepends and abutment backwall.

The falsework for the deck forms consists of timber pile bents, the pile spacing being carefully varied to suit the loading. It was necessary to drill holes for some of the piles and they were driven to a maximum bearing of 40 tons.

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Lighting will play an important part in making this structure safe under traffic. Soffit lights of advanced design will set in deck ceilings, supplied by cable set in conduits cast along the curb lines of deck slabs. Lighting details are still being worked out at this writing.

The design of this structure was developed by the California division of highways bridge staff at Sacramento, under F. W. Panhorst, assistant state highway engineer. The Los Angeles branch office of the bridge department, under J. W. Green, made preliminary studies and is supervising construction in cooperation with the division's Los Angeles district staff which has jurisdiction over the roadway part of the project. H. R. Lendecke, associate bridge engineer, is resident engineer on the project; B. N. Frykland, associate highway engineer, is assistant on roadway work; R. K. Harris is project manager for J. I. Barnes Construction Company.

80 Federal Construction Agencies—There are approximately 80 construction agencies in the Federal Government. However, the major activity is performed by the following: The Army Corps of Engineers; the Navy Bureau of Yards and Docks; Bureau of Reclamation; Department of the Interior; the Federal Works Agency—which includes Public Roads, Public Buildings and the Bureau of Community Facilities; and Housing and Home Finance Agency.

ROADS AND STREETS, September, 1948

# FALL AND WINTER PROBLEMS

# **Rock Salt**

# Melts Down Lansing Snow Removal Budget

By Palmer H. Slack

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Assistant Director of Public Service City of Lansing, Michigan

To combat snow storms and icy street conditions effectively, the municipal department charged with the responsibility of ice control and snow removal must carefully prepare in advance methods of attack, be staffed with experienced and trained personnel, be equipped with sufficient and proper pieces of equipment, be stocked with sufficient amount of materials for ice removal, and be financed with sufficient funds to carry out the program successfully.

The Department of Public Service in Lansing has made many observations and studies during past winter seasons for the purpose of improving the city's ice and snow removal program each year to the extent of removing ice and snow as rapidly and economically as possible.

As a result of these studies, the De-

partment has reduced costs approximately 15% by using rock salt for ice removal purposes. In addition, a further saving of approximately \$5,000 a year has been reflected in the cleaning of sewers and catch-basins and pavements in the spring. In previous years it was necessary to spend this sum to remove sand that had accumulated on the pavement and in the sewers during the winter season.

Approximately 80 miles of Lansing's 193 miles of streets are indicated for non-skid treatment as the first work to be performed at the beginning of a storm. The state trunk lines, the downtown district and other primary streets are treated immediately with rock salt to prevent the formation of ice on the pavements. For light snowfalls—two inches or less—rock salt has performed successfully the job of snow removal, eliminating the necessity of plowing. In heavy snowfalls the second application is made after plowing

with excellent results—a dry pavement over which traffic may proceed safely.

During the winter months, two men—truck driver and helper—are assigned to each of the two night shifts for the purpose of "salt spotting"—that is, using rock salt at intersections, traffic lights, railroad crossings and steep grades—during light snow flurries and to observe the progress of the snow. If indications are such that the storm will require the entire crew, the field superintendent is called by phone and he in turn mobilizes them.

It has been determined that "salt spotting" produced excellent results because traffic will track the brine produced by the salt's chemical action as much as one block either way from the intersection. It is obvious that a considerable saving is made, since the work performed during the night by two men produces dry pavements before the morning traffic is heavy and also eliminates the necessity of mobilizing the entire crew in the night.

Rock salt has performed successfully with temperature as low as zero. During the early morning hours, between 3:00 a.m. and 7:00 a.m. when the temperature approaches zero, rock salt has been applied many times with very satisfying results.

Three graders and ten truck plows are operated by the department for snow removal purposes, and rock salt is spread by means of a Burch spin spreader, a total of ten being used by the department. For the downtown business district and outlying business district a Snogo with a fleet of six to eight trucks is used for loading and hauling snow from these areas. During heavy snow storms two or three graders are rented from contractors for plowing streets in residential areas until such time as the storm is under control.

The Department of public service is headed by Glenn P. Manz, director and city engineer who with Palmer



★ Michigan uses automatic spreaders like this to distribute rock salt evenly over state highways

H. Slack, assistant director, formulates the general policies and methods for ice control and snow removal. The Engineering Division of the department headed by Collins E. Thornton, assistant city engineer, pools its

equipment and personnel with the Public Works Division to combat storms. Direct supervision of personnel is under Frank Haywood, Public Works field superintendent.

# **Detroit Heavy Chloride User**

## By Frank Stang

THE basic plan of snow and ice removal in the City of Detroit consists of salting and plowing on main traffic arteries and complete removal in the downtown or "loop" area.

This plan is possible, because our winters are comparatively mild both as to temperatures and snowfall. The average season total snowfall from 1931 to date is about 29 in. with the single fall rarely exceeding 4 in. With this amount of snow and temperature ranging from 20° to 30°, the use of salt is ideal and often the only operation required.

With the exception of the "loop," having an area of approximately one square mile, the snow clearing activity is confined to main traffic arteries. These arteries form a network of north-south and east-west streets for movement of traffic both out of the city and across town and the total length of these streets serviced is approximately 450 miles.

No attempt is made to clear residential streets, as the cost would be prohibitive to care for the 2,000 miles of paved streets in the city.

The snowfall has rarely been enough to completely stop traffic, but in most cases a fall of .2 to .3 inch will seriously hamper movement of vehicles due to the ice condition that forms.

The general procedure in handling snow is as follows: All equipment is put in condition, schedules prepared, and crews assigned at least by the first of November.

Reports are received hourly from the Weather Bureau when conditions indicate an approaching storm. These reports may be received at shorter intervals when a pronounced change in conditions develops. Much of the success in prompt clearing of snow can be attributed to the co-operation of the Weather Bureau and the accuracy of their reports.

When we receive a report of a snowfall, crews and supervisors are alerted and trucks are loaded with salt in readiness for dispatching to previously designated points.

Salting is the first process regard-

less of the amount of snow predicted as the presence of salt usually prevents formation of ice on the pavement.

The amount of salt needed is dependent to a great extent on the temperature and as a consequence the thickness of the application must be left to the experience and judgment of the operator. At times it has been necessary to make a second application to produce good results. This is true especially when the storm continues beyond the time of salting.

Plowing is seldom resorted to for a snowfall of less than 3 inches. When snowfall of greater depth than 3 inches is predicted, plows are mounted on trucks previously selected and prepared for that part of the work. Snow is plowed from the center of the street to the curb and in the process some of the salt, previously spread, is carried along and mixed with snow.

#### **Equipment Used**

The principal items of equipment used are salt spreaders, plows, and light portable loaders to handle salt from stock pile to truck.

The salt spreaders are arranged to attach to the back of our standard

open-body truck, operate by gas motor independent of truck and have manually controlled feed gates. The regular tail-gate of the truck is replaced by one of our own design to control flow of salt into the spreader hopper. Plows are of the reversible type with 36 inch mold board 10 ft. long.

These are attached to our rubbish collection trucks which have previously had plow attachments mounted. Salt is usually loaded in the body to increase traction. This past winter we used the truck tractors which are part of our flusher equipment and found them very satisfactory even without auxiliary ballast due to the light plowing required.

Our experience indicates that the best size for our purpose is the one known to the trade as CC size. This past season we had to accept a coarse grade with sizes ranging from ¼ in to % in. This size does not produce as good results as the CC grade normally used, or to put it another way requires more salt for the same results.

The City of Detroit has not used mechanical loading to any extent at any time and practically eliminated it during the past few years, because we feel a capital investment in equipment that will be used at most once or twice a year is not good economics.

The efficiency of loaders is greatly reduced by the problem of parked and stalled automobiles, and our only solution to this problem when we did use loaders was to have a police detail assigned to us with a tow truck to move the cars as required.

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A few points in closing about the use of salt: we use from 10,000 to 13,000 tons each season, depending on the number of times an application is required.

# "Anything Can Happen"

The accompanying photograph taken at Richland County, North Dakota, shows a Model YU FWD, one of two recent additions which served the county last winter. Both trucks are equipped with "V" type plows and 10-ft. wings. They are stationed about 60 miles apart in the county and each truck handles approximately half of the county—240 miles of road.

When the county's first 4-ton all-wheel-drive truck was delivered in 1944, it was the heaviest piece of equipment owned by the county. It was sent over to the county when the going got too tough for smaller trucks. Accord-

ing to Emil Berg, driver, snow conditions here are such that anything can happen. During the winter, plowing is usually done under conditions of extreme cold and constant drifting. The land in this section of North Dakota is mostly flat, the roads are usually graveled, sometimes narrow and inclined to turn shortly so that it requires all of the driver's attention to follow the road. In the spring of the year thawing and freezing conditions combined with drifting will build a snow drift with layers of ice in it. It takes a lot of power to move snow under these conditions.



★The snow plowing scene in Cavalier County, North Dakota, which follows a system of plowing with grader and truck similar to that of Pembina County. The motto in this part of the world is "throw the snow clear off the road."

# Motor Grader Opens Fast V-Plow Clears

THE system used by Pembina County to clear its roads is summarized as follows:

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(1) A heavy motor grader hits the drift, opening a hole through if it is able.

(2) If it is unable to go all the way through, a 4-ton truck backs up and hits the drift at 25 to 35 mph.

This sequence continues until a onelane opening has been made.

(3) Then the motor grader, using either a "V" plow or a blade, shaves off wind-blown snow. The wing is usually found useless because it cannot be held down hydraulically, and it rides over the banks.

(4) The 4-ton truck hits this wind-

blown snow and throws it as far off the road as possible, usually spreading the snow as far as 30 ft. from the edge of the road. This process is repeated until the wind-blown drift has been eliminated as much as possible.

Although the system takes a long time for each drift, the work proceeds rather rapidly, as the drifts are few and far between. A drift 4 to 5 ft. deep and 20 yd. long will take about an hour. The almost constant winds keep the open roads swept clean of snow.

One drift that was not cleared last winter was on a little-used side road. It ranged from 10 to 7 ft. in depth, and was at least 100 yd. long. The snow was packed in so tightly that a passenger car could be driven on top of the snow without making a rut.

### **Traffic Packs Drifts**

Pembina County's road foremen report that their work is made tougher by people driving over the snow drifts while forming. This is liable to make a rutted drift with a 2 to 3 ft. layer of ice and snow hidden underneath the newest snow. This cement-like layer, under a fresh blow-in almost as hard, is very difficult to remove.

The snow in North Dakota is variously called sugar snow, sand snow and hard snow. It is snow mixed with top soil blown in from the nearby fields and in one reporter's opinion, it should be called "cement snow." Besides, the drifts freshly plowed are so hard that one has to kick foot holes in the drifts in order to climb them.



\* In Richland County each truck gets over 240 miles of road



# Scaffold Platforms Built Integral with Bridge Pier Forms

A S The Contracting Division of Dravo Corporation progresses on the construction of the substructure for a new 1,931-ft. bridge across the Monongahela River near Pittsburgh, attention is drawn to the safety measures being used on the project.

The substructure is comprised of

twelve 90-ft. concrete piers, ten on land and two in the river, and two abutments. To provide maximum protection for workmen, complete scaffolding was built integrally with the wooden forms used for pouring concrete. The forms were placed in position by whirler cranes with 130 ft. booms. On these scaffolds the handrail posts are installed at 135-deg. angles to the scaffolding so that the top rails are situated 2 ft. further out than the scaffold planking. The area between the top rail and the scaffold is covered by 1-in. wire mesh.

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and small loads can be carried safely on the stairways.

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Besides "building" safety into the job, all workmen are provided with personal protective equipment, as required, including goggles, welding hoods, safety belts, Kapok-filled life jackets, and hard hats. Employees are required to take medical examinations when hired. Each is given a copy of Dravo Field Safety Orders, for which he signs a receipt. Regular safety meetings of supervisory personnel are held every three weeks to discuss current problems.

In addition to the installation of fire extinguishers at strategic locations throughout the construction area, a 2-in. water line has been run into the job site and hydrants with attached hoses are placed near major building.

During the early stages of the work. Dravo's Safety Department in collaboration with the Allegheny County Traffic Engineer, made a traffic study of the project area. Eight warning signs were placed at appropriate locations to inform motorists about the job, and flagmen are assigned as needed.

# Bulk Cement Hauled in Mixer Trucks

The following interesting letter was published recently in Technical Information Letter No. 40 of the National Ready Mixed Concrete Association. The letter was received from a company belonging to the Association, replying to an inquiry by the Association's director Stanton Walker.

"When it seemed that the car shortage was upon us, we sent one of our trucks, equipped with revolving-drum body capable of holding 8 cu. yd. (216 cu. ft.) of water, to a nearby cement mill. There it was loaded with 38.75 barrels of cement. However, it is believed that a drum of this size and type could carry as much as 40 barrels. The drum was not revolved during the return trip. The cement settled considerably by the time it had reached our plant.

"The cement was unloaded into the screw under the railroad track where we normally remove bulk cement from hopper cars. We merely put a tarpaulin over the end of the mixer truck and revolved the drum to discharge the load. There was a surprisingly small amount of dust and the cement was fully discharged without difficulty.

"The only figures we have on the cost of transporting cement are for the one trip just described. The trip log is as follows:

Round trip from our plant to cement mill.... 35 miles



Running time round trip..2 hr. 15 min.
Loading time at mill....... 12 min.
Unloading time at plant.... 10 min.

Total elapsed time for

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 $$4.30 \times 2.75$ 

----=\$0.295 per barrel

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"On the basis of 5% barrels of coment per ton, the cost would be about \$1.57 per ton or, based on the one-way distance to the mill, \$0.09 per ton mile.

"I do not know how this method of handling cement would work out in normal practice. It might be possible, for example, to haul the day's supply of cement at night. This would certainly be the happy condition for getting the most out of one's equipment.

"We have also used in the past other vehicles for transporting bulk cement. Some years ago we handled cement in a closed aluminum body, roughly a trapezoid in cross-section, mounted on a large 4-wheel, 8-tired trailer. It was towed by a 4-wheel-drive tractor.

"An old dump body, after some modification, has also been used for handling bulk cement. The body was mounted on a semi-trailer in such a manner that it could dump in the usual fashion. The rear gate was welded tight and a door placed in it with fillets to the side walls of the body to permit full discharge of the load. The top of the body was equipped with a cover having three openings fitted with cotton sleeves; the openings could be covered with

## Loader Handy for Cleaning Small Slides

Also seen on US 40, but this time in Colorado, is the Scoopmobile pictured here. Because of its over-theroad mobility and flexible one-man operation, it has been used over a considerable mileage for cleaning up small slides where there aren't too many boulders present. In the instance pictured, the machine simply scooped up a load, working straight into the bank or parallel to it, and dumped over the edge of the fill on the other side of the road.

lids. The sleeves were used to connect with the discharge of the bins at the cement mill."

## Special Trailer for Shovel Boom

When the personnel of the Public Construction Co. of Denton, Texas, wants to move the front-end of their 1½-yd. Northwest shovel over the road, they need to send only a trailer truck and driver. He pulls up near said shovel, noodles a specially designed trailer up to the front of the shovel, whereupon the shovel operator lowers the boom and dipper onto the trailer, the boom is unpinned, and the driver takes 'er away.

Much labor and time are thus saved for this contracting organization. The trailer in question, specially designed for this shovel, was fabricated in the contractor's shop out of standard steel shapes. The bed and frame of the trailer were designed to such dimensions and height from the ground that little or no shimming is necessary to transfer the front-end assembly. Strictly a one-man deal, and a handy unit when it's time to take a boom into the shop for fixin' or to change

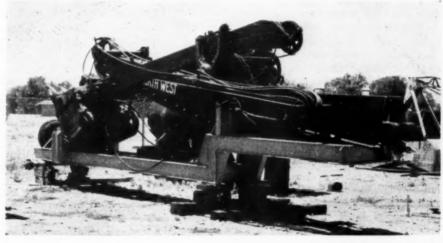
from shovel to dragline or other work. The contractor finds it easier to remove boom for any move over 10 miles. The shovel even with boom off is moved under permit in Texas. Removal of boom for 1½-yd. Northwest takes 20,000 lb. off the load and reduces overall height to about 13½ ft.

The photo shows the details of this rig, as she sits blocked up sans-wheels in the contractor's yard.

# Snow and Ice Control Costs Are Higher

Typical of the rising costs of winter road and street maintenance are those reported for the city of Rochester, New York, for the 1947-48 winter. Cost of keeping streets open and safe for the winter was \$661,000, compared with \$585,000 for the previous winter. Total snowfall up to April 3 was 68.4 inches, compared with 75 inches the previous winter.

Last winter the crew was called out on 49 nights. Salt used cost \$119,600 compared with \$86,000 the winter before. Sidewalk clearing was less—\$88,000 compared with \$119,200. These figures from a news item credited to city comptroller W. R. Whitley.





# **Setting Slope Stakes** Made Easy

By D. K. Heiple

Chief Field Engineer R. G. LeTourneau, Inc., Peoria, III.

Setting slope stakes by ordinary methods is a trial-and-error proposition, the number of trials dependent entirely upon the experience and judgment of the engineer.

A quick method of setting stakes is possible, however, by use of the hand level with quadrant, or transit, depending on the accuracy desired. In either case, the method is the same.

1. First, the quadrant is set to the desired degree of slope, then-

2. For slopes in fill and working from the shoulder, the instrument is held at grade level. The toe stake can then be set directly at the point the line of sight intersects the ground line as in Fig. A.

3. For slopes in cut work, is also carried from the shoulder with the instrument set for the desired degree of slope. The amount of cut at the shoulder is added to the height of instrument to obtain the rod reading which must be obtained. The rod is then moved uphill until the line of sight intersects this reading and the slope stake set at the ground point of the rod as illustrated in Fig. B.

4. The limitations on this method are the height of the surveyor and the length of the rod, since cuts of fills of over 5 to 6 feet will put the sights beyond the physical reach of one or the other. However, a variation or two on our setup will produce the same net

5. Consider first a fill of 7 feet. Eliminating the possibility of standing on something for the sight, hold the rod at the shoulder and move uphill with the instrument until the line of sight passes through 7 on the rod, again driving the stake at the intersection of the ground line with the line of sight. This method is not practical in level country, but under those circumstances setting stakes by conventional methods is a simple matter.

6. Next, let us consider a cut of 12 feet which added to a height of instrument of 5.2 feet would put our line of sight at 17.2 feet, or 5.2 feet over the average 12 foot rod. Proceeding in the same manner as in section No. 3, with the instrument set for desired slope, sight uphill from the shoulder and move rod uphill until the height of the instrument from the rod (12 -5.2 = 6.8). This distance in turn subtracted from the necessary reading of 17.2 feet gives the reading for the next turn uphill (17.2 - 6.8 = 10.4). From the spot the rod is grounded

Fig. A SURVEYOR'S ROD-HAND LEVEL SET FOR SLOPE AND HELD AT GROUND GRADE GRADE LINE OF ZLINE OF SIGHT FINISHED ROAD SLOPE STAKE Fig.B SURVEYOR'S ROD 2 ZTARGET SET AT 9.2" GROUND LINE LINE OF SIGHT HAND LEVEL SET FOR DESIRED DEGREE OF SLOPE SLOPE STAKE 4.OCUT/// 5.2' HEIGHT OF INSTRUMENT ABOVE GROUND GRADE LINE OF | FINISHED ROAD Fig.C. LINE OF SIGHT 52 HEIGHT OF SLOPE STAKE INSTRUMENT ABOVE GROUND ORIGINAL GROUND L GRADE LINE OF FINISHED ROAD

sight again and move the rod uphill until a reading of 10.4 is obtained. Drive the stake at the point the rod is grounded. This procedure can be repeated indefinitely as illustrated by Fig. C since it is only a matter of projecting parallel lines.

We do not suggest that this method can replace the accepted procedure in all cases, but offer it only to the solution of such problems as in the surveyor's or engineer's judgment are within the practical limits of the accuracy possible. We feel that it does offer a direct method of setting stakes quickly for many jobs.

# **Engineering Approach to** Traffic Safety

(Continued from page 56) effectiveness the engineering approach to traffic safety should be four-fold.

First, there is the use of engineering procedures in studying, analyzing and interpreting facts about the highway transportation system. Engineers can help a lot in guiding the analyses of accident statistics, traffic volume,

speeds, enforcement, driver licensing and vehicle inspection.

The second engineering approach is in building safety into highways. Good alignment, good visibility, easy side slopes, ample roadways, shoulders and bridge widths, hard dry surfaces, wellmarked highways are all important factors which cut down the accident rate.

The third engineering approach is in traffic operations-in making the most efficient use of the existing street and highway system. This involves the study and treatment of high accident locations, speed zoning and the intelligent use of standard signs, signals and pavement markings.

The fourth engineering application, sometimes overlooked, is the active participation by engineers in coordinated planning of the complete accident prevention program. Coordination of enforcement, engineering, accident records and educational activities is essential for maximum effectiveness of traffic accident prevention programs.

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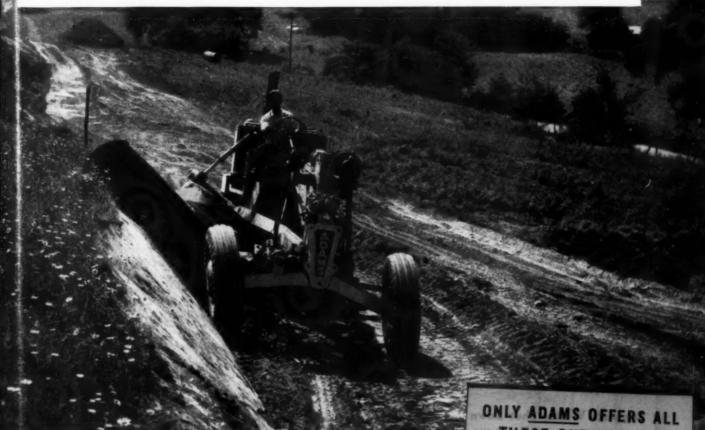
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# Adams advantages pay off on highway construction jobs



Adams Motor Graders are "made-to-order" for rough, tough highway monstruction jobs. Built with an extra measure of strength and stamina, they've pot plenty of power and weight for making heavy ditch and bank cuts—for punching shale out of hillsides—for scarifying hard surface material and dearing it from the right of way—for every type of work, in fact, for which motor graders are designed.

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MOTOR GRADERS . LEANING WHEEL GRADERS . ELEVATING GRADERS

### A Contractor Makes Suggestions For Reducing

# **Hot-Mix Paving Costs**

Excerpts from a talk given at the 1948 Highway Conference, Texas A&M College.

#### By W. M. Jagoe

President, Public Construction Company, Denton, Texas

IN reducing costs, it is elementary that the lowest costs come from maximum production and use of the lowest price materials, so long as the results obtained are up to the standards we know must be met.

Maximum production results from a combination of many things such as men, equipment, weather and a minimum of lost time. It is true we can do nothing to control the weather and in this case I am inclined to go along with the man who said when he could not whip his opposition, he joined them. While we cannot exactly join the weather, we can to a large extent take out and let the weather have its way.

#### Suggests Winter Shut-Down

In this connection, I would like to see the Texas highway department prohibit any hot-mix construction from December 1st to March 1st except in certain parts of the state and only to finish up jobs after December 1st which are nearly finished anyway.\* I know the jobs could be up to a higher standard and the contractors would be better off financially. My records over a number of years show that hot-mix work, done during December, January, February and March, costs as much as 50% more than work done during the other months of the year.

This brings up the question of

\*This idea has been adopted by the Texas highway department. The subject is amusing to Northerners who shut down as a matter of course—Editor.

W. M. Jagoe

changing the procedure the highway department has been following. If the department could, by November, know the jobs to be done the next year and start letting these jobs by November and continue through December and January, the contractors would know what to plan for and could be ready to go to work by March 1st and have the best part of the year ahead, the time of the year of lowest costs.

In this connection, each job should not have a limit as to the number of working days; instead, require that it be completed by December 1st or in the case of the extreme northern part of the state, by October 1st or October 15th.

With the knowledge that he could continue to bid until he reached the capacity of his plant or plants, the contractor could begin to make his plans and by the January letting he would have his hot-mix program for the year outlined and his various moves so arranged as to eliminate any back-tracking, etc. Moving and setting up the average asphalt plant is an expensive proposition and unnecessary moves and set-ups should be eliminated as much as possible.

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Usually materials can be contracted for in the fall of the year for delivery next year cheaper than they can be bought in the spring or summer. This is very true of asphalt. At he present time (late winter) I am buying asphalt on contracts entered into last fall several dollars a ton cheaper than current quotations.

#### Better Inspectors Mean Lower Bids

Should the jobs be handled on the basis of December 1st completion, a suggested method of handling the inspection is as follows: Instead of each district being required to have a plant inspector and a road inspector, these two men could be assigned to the job by the Austin headquarters office. With these two men representing the only necessary trained personnel, the district could easily furnish the checkers, weighers, etc., on short notice and at no very great inconvenience, regardless of when the contractor moved in. However, since the contractor would have a good idea of his time-table, he could tell the district about when he would be on the job in question.

This method would more or less insure experienced personnel on all jobs, and this is quite an item towards good pavements and lower costs. My experience has been that in nearly every instance where the engineers had had no previous hot-mix asphalt experience my costs were higher than they should have been. However, I have had jobs under these same engineers later and the costs came back in line.

Good hot-mix asphaltic concrete is nothing more than a mixture of asphalt, aggregate and common sense. General specifications and certain limits can be set but there is no substitute for experience, either on the part of the engineers or the contractors. The only way I can get efficient

Some of these suggestions have since been acted upon by the Texas highway department, which as a policy encourages free expression of ideas such as are presented here. Although climatic conditions vary in different parts of the country, and each highway department has its own variations in procedure for contract letting, inspection, and other matters discussed here, these suggestions will be read with interest in many states. The principal of cooperating to the fullest with contractors, to aid them in advance planning of operations, is fundamental to construction efficiency in all states—Editor.

ROADS AND STREETS, September, 1948

operation is to use the same men on the same jobs as much as possible.

Having the key men of the asphalt inspection crew work out of the Austin headquarters office and under one man would tend to standardize the procedure and construction. Under the present system we are in effect working for 25 different highway departments (25 districts). Often moving from one district to another is like crossing the state line.

#### More Working Days!

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Since the output of an asphalt plant in a season is its daily output multiplied by the working days, it stands to reason that if we can increase the working days during the months we can accomplish the most, we will end up at the close of the season with the maximum amount of work done which after all is what brings costs down.

A hot-mix contractor has a considerable investment in equipment which cannot be used on other types of construction, and he must be able to get maximum production if he is to keep his costs down. This can only be accomplished by the fullest cooperation between the highway department, the district engineers, the resident engineers and the contractors themselves.

The current high cost of asphalt and the recent increases in freight rates are a matter of much concern to all of us, and if costs are to be kept down or reduced, thought must be given to ways to reduce the amount of asphalt used in the mix and the use of local aggregate where possible. The use of local aggregate should be given more thought at the present than in the past because of the car shortage. Not having material can be very costly and very annoying.

#### Two-Course Jobs Pay

The tendency on most hot-mix jobs is toward two courses and this is a step in the right direction. I am a firm believer in two courses and thicker pavements than have been laid in the past several years. In my opinion it is false economy to lay a thin surface with the idea of coming back later with another course. The idea in a way is all right but usually later is too late. Frankly, I think a job built between Tyler and Gladewater in 1938 has done the hot-mix business more harm than good. It is one inch thick but was laid on a perfect iron ore base. The fact that this one-inch surface course took the punishment through the years has caused some engineers to think that one inch is enough. This is the reason I say because hot-mix is a good pavement, we expect too much from too little.

Under any other conditions this surface would not have stood up.

In two courses (of Texas type D) it is much better and cheaper to allow at least 125 lb. per sq. yd. for the finish course, because 125 lb. per sq. yd., half-width, is about as thin as can be laid with a spreader and keep up with a large capacity asphalt plant.

#### Blade the Leveling

Our experience with level-up courses is that the best and cheapest way to lay them is with a good tight motor grader followed by a rubbertired roller. Two motor graders and one rubber-tired roller and one tandem roller can handle the output of most any plant and spread as low as 50 lb. per sq. yd. If a fine-graded mix is used for the level-up course, the entire job can be leveled before the surface course is started. This method makes for cheaper operation and in my opinion makes for better construction. The traffic does a good job of compacting the course, thus reducing the danger of the surface becoming rough under traffic through subsequent compaction. A modified sheet asphalt level-up course will not ravel as badly under traffic as a coarser (Type D) mix and can be worked into the cracks in the pavement much betThe thicker the surface course, the larger the top size of the aggregate and in turn less asphalt. The plane of weakness between two courses of equal thickness is eliminated, and the tendency to shove under traffic is lowered.

#### **Who Cleans Joints?**

Some uniformity between the districts as to who cleans the old pavement, joints, etc., should be established. Some districts do this work with their maintenance forces and some require the contractor to do the work. The exact meaning of the word "clean" can vary as much as \$0.20 per ton for cleaning the base.

The use of round openings in the specifications sometimes causes additional expense, particularly in the case of local production. Often to get under the oversize tolerance on a round opening when the material is being produced with square screens will result in excess fines and higher costs, yet the oversize is very slight. I am not suggesting changing to a square opening for the specifications but I would like to see the department make up an alternate specification based on square openings. In some districts this small oversize does not matter but in others they kick up (Continued on page 112)



"THE JOB WAS GOING FINE. I HAD AN IN WITH THE BOSS.
THEN I BEGAN TO GET SOME BRILLIANT IDEAS ABOUT
SOME NEEDED CHANGES IN THEIR CONSTRUCTION
METHODS - NATURALLY THE ONLY CHANGE THEY MADE
WAS ME...."



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# Closing the Gap Between Research and Practice

By C. A. Hogentogler, C.E.

# More About Mathematical Theory and Research Data

Continuing a series of articles, the purpose of which is to discuss the field of highway research, a field which a number of authorities claim is not linked closely enough to the practicing highway engineer. The author uses a new and necessarily bold line of approach to clarify some of the basic concepts and some of the confusion that seems to exist in the whole field.

Comment and discussion are invited, addressed either to The Editor, Roads and Streets, or directly to the author, at 1927-37th Street, N.W., Washington, D. C.—The Editor

COMMENTS received on the article entitled "Mathematical Theory, Research Data and Common Sense," indicate that more space might well be devoted to an effort aimed at bringing the first two of these sources of road-building knowledge into better focus with each other.

#### Simple Formula Illustrated

Discussion of the two best known theories on concrete pavement thickness serves admirably for this purpose. It begins with the magazine *Public Roads*, April, 1919. It was here that A. T. Goldbeck first suggested a formula for computing the edge thickness of such pavements. The formula had the form:

$$d = \sqrt{\frac{3W}{g}}$$

in which

d = thickness of the pavement slab in inches

W = wheel load, in pounds, applied at the extreme corner of the S = modulus of rupture of the concrete in pounds per sq. in.

Values of the modulus of rupture are determined by tests performed on small samples of the concrete in either the laboratory or the field.

At this time, the expression had no status other than that of pure mathematical theory. In other words, it was nothing more than Mr. Goldbeck's opinion expressed mathematically. This opinion was based on just two assumptions as follows:

1. That the modulus of rupture of the concrete in the pavement was the same as that of the tested concrete

2. That the corner of the concrete slab received no support whatever from the subgrade beneath.

After the Bates Road accelerated traffic tests, and the supplementary laboratory tests of the "fatigue" or "tiring out" of concrete under repeated loading, Clifford Older reported in the *Trans. A.S.C.E.*, 1934, as follows:

"The plotted points in Figure 17 (a) show the relation between the loads causing critical corner breaks and base thicknesses for various types of construction. The curve passes through the points determined by the formula

$$d = \sqrt{\frac{3W}{S}}$$
, or  $W = \frac{1}{3} Sd^2$ .

These diagrams indicate that the formula, when used in connection with the design of rigid pavement slabs of fairly constant cross-section and having no special provision for edge strengthening, may be used with considerable confidence.

"In Fig. 17 (g), the plotted points represent the loads causing critical corner failures in all sections of the rigid type. These points were plotted

in the same position relative to the curve determined by the formula

$$d = \sqrt{\frac{3W}{S}}$$
, using for S the average

modulus of rupture of all test specimens), as they appear in Fig. 17 (a) to (e). In this diagram, attention is called to the grouping of the plotted points about the curve representing the theoretical breaking load as determined by the formula given. It will be noted that the lower curve, in which 50 per cent of the modulus of rupture was used, gives safe values for all cases causing critical failure.

"Self-supporting edge corners may be insured by proportioning the thickness of the slab edges by the formula

$$d = \sqrt{\frac{3W}{S}}$$
, in which the value of  $S$ 

should not be greater than one-half of the modulus of rupture of the concrete used. It is suggested that this thickness should be maintained for a distance of at least 2 feet from the edge and then decreased in another 2 feet to the mid-portion thickness, inasmuch as initial corner breaks rarely extend more than 2 feet from the edge of the pavement."

In a discussion of Mr. Older's paper in the same *Transactions*, H. F. Clemmer adds the following:

"The prime development from highway research in Illinois has been checked and proven practical for use

in the formula, 
$$d = \sqrt{\frac{3W}{S}}$$
. Concrete

roads designed under this formula and on which traffic loads are properly controlled will last indefinitely."

This is a typical example of the value of research data for changing an engineering opinion into an established fact; for what had been pure mathematical theory in 1919 became in 1924, insofar as the State of Illinois was concerned, a practical and valuable working tool of design.

In 1938, in a book entitled Reinforced Concrete Pavements, the late Royall D. Bradbury makes use of this formula in what he terms an "Approximate Determination of Thickness."



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He suggests also that the thickness of the interior portion of the slab need be only about 70% of that given by the formula. He agrees with Mr. Older that the value of S used should not be more than 50% of the strength of the concrete as determined by test; and suggests, furthermore, that suitable values of W for use in the formula are as follows: (a) For heavy duty routes. 12,000 lb.; (b) for normal heavily. traveled rural routes, 9,500 lb.; for routes carrying a reasonably heav volume of traffic, 7,500 lb.; and for routes carrying a moderate volume of traffic, 6,000 lb.

It is not within the province of this article to consider either the accura v or the incorrectness of results furnished by the formula just discussed. The writer introduced it for just two purposes: namely, to demonstrate fir t. how research data can serve to change a strictly mathematical theory, at least to the satisfaction of one state his hway department, into a usable working tool of design; and secondly, to illustrate an expression which is conspicuous because it is the acme of simplicity. In this latter connection, please note that except for possible slight variation in values of the modulus of rupture, S, to be used in the computation, all parties making use of the formula must, of necessity, obtain the same value of pavement thickness d; for equal magnitudes of the wheel load, W assumed.

#### Complicated Analysis Illustrated

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Compared with this will be the socalled "Westergaard Equations" which involve the use of a relatively large number of assumptions. The classical "Theory of Elasticity" constitutes the basis of these equations, and in at least the field of foundation engineering, there is some question as to the extent to which this theory is applicable to foundation soils. This is indicated by Professor D. P. Krynine in the Proceedings of the Eighteenth Annual Meeting of the Highway Research Board, 1938, Part II. He states:

"The only scientific tool at our disposal for determining the stresses underneath a foundation is the mathematical theory of elasticity which deals with homogeneous, elastically isotropic bodies. . . . Soils are neither homogenous, nor elastically isotropic. Since stresses cannot be computed exactly, owing to the difference between an elastically isotropic body and the actual earth mass, it is not worth while for a foundation engineer to compute them very accurately, using complicated formulae."

In order to thoroughly understand the full significance of this statement the writer had to refresh his memory on several of the terms made use of. According to Webster, he found them

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defined as follows:

"Homogeneous: Consisting of elements of like nature."

"Isotropic: Having the same properties in all directions."

"Elastic: Capable of recovering the same size and shape after being deformed."

However, Dr. Westergaard's decision to make use of the theory of elasticity in his method of stress analysis was not the result of mere guess work but was based, instead, upon factual data.

#### **Elastic Quality Demonstrated**

The investigation reported in *Public Roads*, April, 1919, involved the use of a number of Goldbeck pressure cells to determine the pressure exerted upon the subgrade by truck wheels placed at different locations upon concrete pavement slabs. The maximum pressure recorded in this investigation had the magnitude of about 6 lb. per sq. in.

As part of the Bates Road investigations, many hundreds of similar observations were made. Again, as reported by H. F. Clemmer and the writer in *Engineering and Contracting*, July 5, 1922, 6 lb. per sq. in. was found to be the maximum pressure which could be exerted upon the subgrade by truck wheels used in the Bates tests. Therefore, when it was decided to make repeated load tests

on the Bates Road subgrade soil, by means of concrete slabs 3 ft. in diameter, A. C. Benkelman, then of the Illinois highway department, selected 6 lb. per sq. in. as the most appropriate pressure to make use of in the tests.

These tests, as reported later by Mr. Older in the *Trans. A.S.C.E.*, 1924, disclosed without the shadow of a doubt that within certain limits this subgrade soil at least, was not only *homogeneous*, but was elastically *isotropic* as well.

It was the writer himself who had the privilege of thoroughly familiarizing Dr. Westergaard with these findings when the latter first began his work of stress analysis with *Public Roads*, in 1924. From his close contact with Dr. Westergaard at that time the writer got the impression that it was these factual data which decided that eminent scientist to make use of the theory of elasticity as the basis of his analyses.

#### Westergaard Approach Praised

From the viewpoint of the practicing engineer, Dr. Westergaard's reports were ideal; from another angle, to wit: he never failed to set down his assumptions most clearly at the very start of his presentations. It would do much to clarify a complex situation if all proponents of new mathematic the-

ory would adopt Dr. Westergaard's pattern of presentation.

Thus, in Public Roads, April, 1936,

"One may obtain a computation of stresses in concrete roads by assuming the slab to act as a homogeneous, isotropic, elastic solid in equilibrium, and by assuming the reactions of the subgrade to be vertical only and to be proportional to the deflections of the slab. With these assumptions introduced, the analysis is reduced to a problem of the mathematical theory of elasticity."

Also in the "Theory of Concrete Pavement Design," Proc. Seventh Annual Meeting of the Highway Research Board, 1927, he states:

"The analysis rests on certain assumptions. First, the wheel loads are dealt with as static loads—that is, the inertia action of the pavement and subgrade under a sudden or moving load is not considered. Secondly, the subgrade is assumed to be uniform, without local soft or hard spots, and to be everywhere in contact with the slab."

Later, another assumption entered the picture. This one deals with the length of the slabs and is given by Dr. Westergaard in *Public Roads*, June, 1929, as follows:

"When cracks form in a concrete pavement, larger slabs of the pave-(Continued on page 80)

# WHY DUMPTOR Maintenance Cost Stays Low in Toughest Service

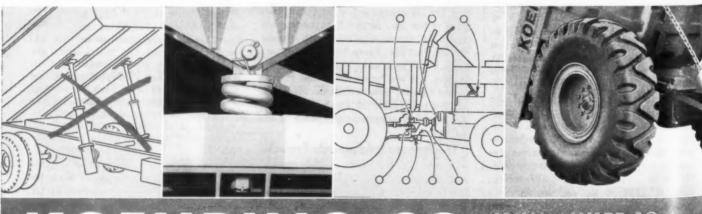


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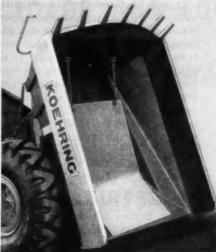
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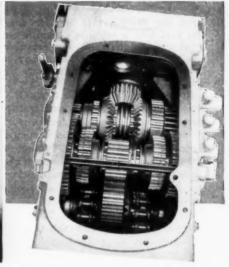
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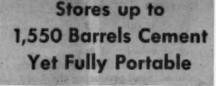
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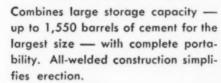
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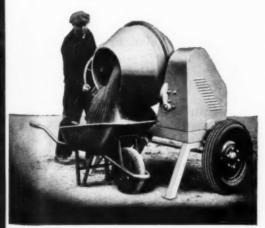
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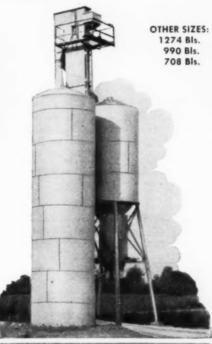


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(Continued from page 77)

ment are divided into smaller ones. The fact that a beam is strengthened by shortening the span, suggests that smaller slabs of the pavement may be less liable to over-stress than were the original larger ones."

In addition to this, the amount of stress due to restrained temperature warping and a given slab length must be assumed for use in the computations.

The total number of assumptions made use of in actual computations can best be illustrated by a specific example. For this example, use will be made of values given in Table 24, "Principles of Highway Construction as Applied to Airports, Flight Strips and Other Landing Areas for Aircraft," published by the Public Roads Administration, June, 1943.

The values are as follows:

#### Estimated Minimum Thicknesses for Concrete Runway Payements

Static Wheel Load	Minimum Slab Thickness
Pounds	Inches
10,000	6
25,000	8
40,000	10
80,000	12

The assumptions made use of in the determination of these values may be listed as follows:

1. The subgrade is of excellent quality such as would be furnised by soils of the A-1, A-2 or A-3 groups, or by a foundation course of these materials from 12 to 18 inches thick placed on soils of the A-4, A-5, A-6 or A-7 groups.

In addition, subgrade soil must be:

- 2. Homogenous
- 3. Perfectly elastic
- 4. Isotropic.

The subgrade must:

- 5. Provide perfectly uniform support at all locations beneath the slab.
- Be everywhere in contact with the slab. Like the subgrade soil, the concrete comprising the slab must also be
- Homogeneous and elastically isotropic.
- 8. Slab length must be 15 ft. only.
- 9. The slabs will be uniform in thickness.
- 10. The total stress in the slab is approximately 500 lb. per sq. in., 150 lb. per sq. in. of which is produced by restraint temperature warping; thus leaving 350 lb. per sq. in. to be produced by the wheel loads.
  - 11. Wheel loads must be static only.

It is on the assumption of the values of temperature stresses and total stresses to be used in the computations, that different persons using the same equations can obtain different values of required slab thickness for equal conditions of wheel load, etc.

It will be noted that as compared with the two possible assumptions made use of in the Goldbeck or Older corner formula, the Westergaard equations involve the use of at least 11 assumptions. And yet, despite the number and validity of these assumptions, long-continued extensive and intensive investigations by the Public Roads Administration under L. W. Teller's direction have shown that the Westergaard equations provide an accurate and complete method for practical use in the design of concrete pavements.

#### Simplified Method Suggested

Now, however, it occurs to the author that a simplification of the procedure might well be considered.

Those engineers who still remember their classes in the subject of Hydraulics, might recall that much of this subject is built around a relatively simple formula which discloses the velocity of water flow. The formula has the form:

$$v_* = \sqrt{2gh}$$

in which

v = velocity of flow

g = acceleration due to gravity

h = head producing the flow

This formula again is a pure mathematical theory, for no water ever flowed with the velocity thus indicated. The factual formula is:

$$v = c \sqrt{2gh}$$

in which e is a correction coefficient, varying from about 0.3 to 0.8 in value, and which had to be determined by experiment and investigation.

In the same manner, why not add a correction coefficient to the Goldbeck formula and adopt it for design purposes, thus giving the expression:

$$d\,=\,c\,\sqrt{\frac{3W}{S}}$$

Thus, with a usable modulus of rupture of 250 lb. per sq. in., the values of c for the thickness values from Table 24 given above become:

Static Wheel Load	Minimum Slab Thickness	Value of c	
Pounds	Inches		
10,000	6	0.55	
25,000	8	0.46	
40,000	10	0.46	
80 000	19	0.39	

With these values of c as a basis, additional values may be estimated as fo'lows:

Static Wheel Load	Value of c	
Pounds		
5,000	0.65	
100,000	0.37	
150,000	0.35	

#### Simplification Highly Desirable

Thus has been illustrated a relatively simple and a highly complicated mathematical theory which, by means of research data, have been turned into usable tools of design. In addition, an attempt was made to indicate how the complicated method of analysis could be very appreciably simplified for every day use; which the writer considers highly important.

There is no objection whatever to the use of highly complicated formulas, if needed to take care of all the variables which enter some problems of design. However, there is always a way to simplify their method of application; and such simplification is essential if the material is to prove of any benefit to the practicing engineer.

E. S. Barber, formerly of the Public Roads Administration, and now on the teaching staff of the University of Maryland, was especially apt at simplifying the application of complicated soi! mechanics formulas for use by the engineer. His method was to develop graphical solutions.

As a typical example of the practical advantage of this method of procedure, reference is made to the computations involved in determining the safe slope of an embankment when the pertinent soil characteristics have been determined by laboratory test. If the complicated formula is used, several hours' work is needed to obtain the answer. Yet, by means of several graphs prepared by Mr. Barber, the writer demonstrated at different times in his soils courses, that the solution could be obtained in exactly 17 seconds.

#### **Graphic Solutions Suggested**

In addition to this graphical solution, it is pertinent to note also that, in collaboration with C. E. Mershon, Mr. Barber has developed similar methods for the solution of a number of principal problems of soil mechanics. These have been published in *Public Roads*, October, 1940.

Finally, in order to prevent any misunderstandings, it should be emphasized that the California Bearing Ratio method of design is not now, and never has been, a mathematical theory. After devising this bearing ratio test, O. J. Porter first (afterward the U. S. Army) and various state highway departments, etc., correlated its results with the performance of roads in service and, in this manner, determined the required thicknesses of flexible pavements on basis of experience, or principles of common sense.

Safety among highway and other workers in the New York State Department of Public Works is the subject of an inter-district safety contest. The Buffalo district took top honors for the first half of 1948, with only 16 lost-time accidents out of 583,000 man-hours worked, or an accident frequency rate of 27.42.

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# Road Factor in Accidents Shown by N. Carolina Survey

IN a recently prepared analysis of accidents occurring on North Carolina highways last year the state highway and public works commission's traffic engineer, R. A. Burch, has arrived at the conclusion that not more than 8.1% of vehicular accidents can be attributed to road deficiencies.

Noting that there is no exact method for determining the causes of highway accidents, Burch in his study sets up a list of the 22 most common causes of accidents. Eight of these possible causes can be attributed to drivers of vehicles, seven can be blamed upon road conditions, and the remaining seven must be classified as miscellaneous. Using this list as a point of reference, Burch has classified individually each of the 5,787 rural accidents reported to the commission last year.

In a majority of the accidents considered, Burch found that the fault lay with the driver of the vehicle, so far as could be determined from the accident report. In his report, 73.3% of the total number of causes of accidents were classified as "driver causes," while 8.1% were listed as "highway causes" and 18.6% of the causes as miscellaneous. In few of the cases studied, Burch pointed out, could the total blame for the accident be fixed upon any single cause, for several factors were included among the causes of almost every accident.

In commenting upon the findings in the analysis, Burch states: "The percentages indicate the great need for education of drivers. The 8% caused by highway effect is small, but it is high enough to demand the attention of the highway commission and its engineers." Cited by Burch as both potential and actual causes of accidents were curves, narrow bridges, bad shoulders, limited sight-distance and inadequate signs.

#### A Significant Study

(Editorial in "North Carolina Highways and Public Works" which also published the foregoing article)

Insofar as it tends to counteract previous false impressions, and also to pose a very real problem, the accident cause report recently completed by Traffic Engineer R. A. Burch is a very significant study. The scope and range of the study was great, and in attempting to work out a basis for the evaluation of accident causes, the traffic engineer performed a valuable service.

The amount of actual effect which the physical condition of highways has had upon accidents in North Carolina has been estimated before, but these estimates often have been based upon false premises and have arrived at false conclusions. In some of the so-called surveys, every accident for which some unfavorable highway condition has been reported has been classed as "caused by the condition of the highway."

In his report, Engineer Burch found that in approximately 8% of accidents reported, a highway deficiency was a major cause, but usually not the only cause of the accident. Certain factors, such as poor sight distance and dangerous curves, were listed as the most important ways in which highway conditions could cause accidents.

The responsibility of the state highway and public works commission does not stop at the mere building of roads and highways, for it also extends to the problem of building them safely. This latter consideration is one of primary importance, and one which can hardly be given too much attention. Burch has served the public in drawing an accurate picture of accident causes, and has served the highway engineering staff in attempting a close analysis of a problem which vitally affects progress in highway safety.

### \$13/4 Billion for Road Construction This Year

America's highway construction program should reach an all-time high dollar-wise in 1948, Charles M. Upham, engineer-director of the American Road Builders' Association, predicted recently in a conference with road officials. He based this belief on the uniform increases since 1945. If the upward trend is maintained, the \$1% billion mark should be reached this year, it was predicted.

October is our peak construction month, declared Mr. Upham. In October, 1946, \$100 million was spent in road building. In October, 1947, this rose to \$178 million. At this rate, October, 1948, should show a total expenditure of \$250 million.

The yearly ratios show practically the same increases—from \$772 million in 1946 to \$1½ billion in 1947.

According to the Federal Works Agency, contracts by state highway departments for the first five months of 1948 amounted to 38% more than the corresponding period of 1947. Federal aid contracts awarded in May of this year were 30% higher than those in May, 1947. State highway contracts awarded in May, 1948, were 31% above those of May, 1947, and total highway contracts at all government levels for May, 1948, were 41% over May, 1947.

Citing figures from the U.S. Department of Commerce, Mr. Upham pointed out that construction in all categories, public and private, was expected to reach a record figure of \$18 billion in 1948. This figure will be \$4 billion higher than the record established in 1947, and \$4½ billion over the previous high reached in 1942, he announced.

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Total construction expenditures for the first seven months of 1948, according to the same source, amounted to \$9,400,000,000, which was 36% higher than the corresponding period of 1947. Residential construction continued to lead other forms.

#### New York State Appointments

Appointment of Holden A. Evans Jr. as executive assistant was announced by Charles H. Sells, New York state superintendent of public works. Mr. Evans was formerly executive secretary of the New York state postwar public works planning commission. He succeeds Francis L. Brown, now deputy superintendent of Public Works, in this \$9000 a year position.



H. A. Evans



F. L. Brown

Most recently Mr. Evans has been Executive Secretary of the consultants under Robert Moses reporting on the public works activities of the federal government for the Commission on Organization of the Executive Branch of the Government, headed by Herbert Hoover.

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#### Research Under Way on Truck Economics

A scientific study of the economics of truck transportation and the relation of truck loadings to highway and bridge design has been launched by the Highway Research Board in co-operation with the Public Roads Administration of the Federal Works Agency and other interested groups.

Ultimate purpose of the study is to determine economic load limits for transport vehicles, taking into account transportation requirements, the cost of hauling, and highway costs.

This is the first time highway research authorities have undertaken a broad investigation in this country to establish the cost per ton-mile in hauling loads of various sizes by trucks over a highway of modern design and over a route embodying low standards of design, typical of a large mileage of roads still in use, a Public Roads official stated.

The initial phase of the investigation, consisting of test runs over the Pennsylvania Turnpike and an adjacent highway built many years earlier to much lower standards, was started July 12 after a number of trial runs for the instruction of operating personnel.

#### 148-Mile Course

This phase of the study will be carried on through August and most of September. The test runs are being made over a course of 148.5 miles from Carlisle, Pa., to a point near Greensburg, Pa., comprising almost the entire length of the Pennsylvania Turnpike, and over US 11 from Carlisle to Chambersburg, then on US 30 to Greensburg, a distance of 149.3 miles.

Trucks used in the test runs range in size from a 2-axle single-unit truck to a 3-axle tractor hauling a 2-axle semi-trailer and a 2-axle trailer. Gross loads, with varied axle distribution, will range from 20,000 to 142,000 lb.

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Each vehicle will be operated with axle loads of 14,000, 18,000 and 22,000 lb., thus providing considerable overlapping of gross vehicle weights between vehicles of different types and affording comparison of the performance ability of vehicles with similar gross weights but with different power ratios.

Speed, gasoline consumption, and wheel slippage on known grades will be recorded. Data on the volume and speed of general traffic on the test routes also will be collected to indicate the conditions under which the test runs were made. Stresses in selected bridges, caused by the heaviest test

trucks while standing and while moving at speeds up to 50 m.p.h., will be measured. Special stress-measuring equipment has been loaned for the purpose by the Association of American Railroads.

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Analysis of the factual data compiled during the test runs will establish the direct cost (fuel consumption and driver's wages) of operation per lon-mile for vehicles of various gross weights traveling over a relatively good and a poor route through rough terrain.

A second phase of the study, to be undertaken later, will provide data on other operation costs, such as expenditures for tires and repairs, and depreciation. Bus operation will be included in this and subsequent phases of the study.

#### **Load Size Preferences**

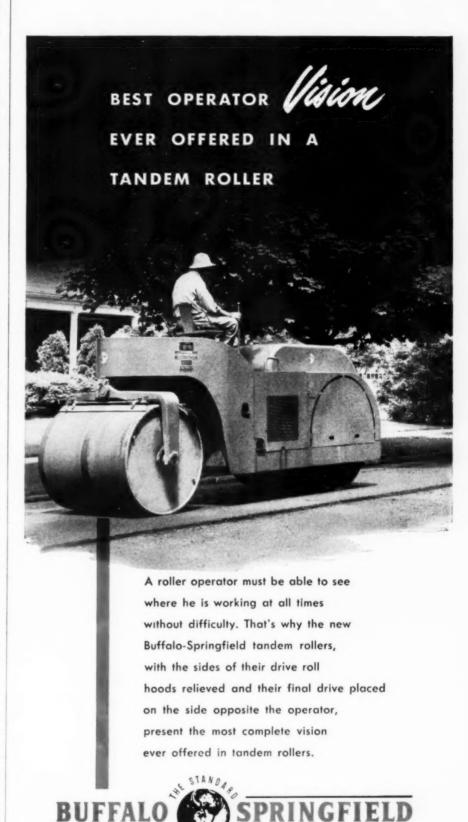
A third phase will consist of a study of the demand for truck transport in loads of various magnitudes, where loads originate, in what size, and where they are delivered. Terminal practices and costs will be examined. The development of truck transportation, it was pointed out, should take into account the needs of shippers as well as truck operators.

Limitation of highway loads has been a controversial subject for many years. Trucking interests have claimed that large benefits would result from loads larger than are now legally permitted, and highway engineers have cited the road damage that might result from a general increase in truck loads.

Final analysis of information obtained in all phases of the study will be helpful in formulating future highway transport policies.

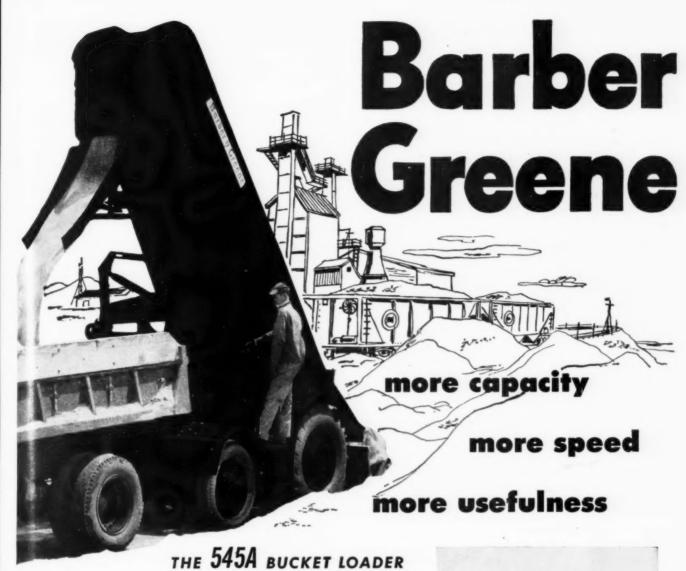
The study, sponsored by the Highway Research Board, is part of the research program of the Board's Committee on Economics of Motor Vehicle Size and Weight. Other participating groups, in addition to the Public Roads Administration, are:

American Association of State Highway Officials, American Trucking Associations, Inc., Automobile Manufacturers Association-Motor Truck Division, National Association of Motor Bus Operators, National Council of Private Motor Truck Owners, National Highway Users Conference, Pennsylvania State Department of Highways, Pennsylvania Turnpike Commission, Society of Automotive Engineers, Truck Trailer Manufacturers Association, Rubber Manufacturers Association, American Petroleum Institute, Office of the Chief of Transportation in the Department of the Army, and the Association of American Railroads.



SPRINGFIELD, OHIO





Every feature in the rugged Barber-Greene Model 545A Bucket Loader helps you to get more yards moved per hour, more jobs done per day.

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, 1948

For instance: there are primary and secondary transmissions . . . a separate crowding clutch . . . three forward speeds . . . a quick reverse. The 8-foot synchronized spiral feed keeps the hard-lipped buckets filled to capacity. Double-wheel drive through big, heavy-duty tires means positive traction and extra power. And you'll like the three-point chassis mounting . . . the light-handed steering.

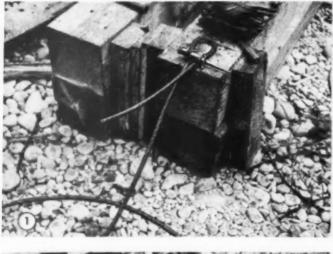
Ask your B-G distributor for the whole story . . . you'll want to put a Model 545A on your payroll.



#### FAST ON THE ROAD, TOO

It's a great time-saver—fast on the road, fast on the job. Notice how the boom nestles horizontally for transport, and how it reduces overall height. Boom can be tilted onto saddle quickly and easily without using a wrench. Takes only a few minutes to get ready to move.















## Making a "Logger's Loop" in the Field

Here is a sequence of pictures that really tells a "home-made" story. It shows with photographic reality how most any workman can loop a rope end even though his prin-

- 1 Here's the starting point. The splicer has made himself a "home-made" vise by nailing down a punch and four spikes on a 12 x 12. He then has inserted the rope in the vise
- Using a larger marlin spike the operator begins unlaying the strands of the dead end of the rope. Notice the helical shape of the preformed strands
- The operator separates the strands with the marlin spike. The rope end is unlaid, ready for tucking. With this type of rope the splicer doesn't need to apply tight seizing wires below the splice end to keep the rope from flying apart and to prevent distortion

cipal tools are a 12 x 12 and a marlin spike. The rope must be preformed in order to be sufficiently flexible; this type of rope is relaxed, easy to handle, willing to turn a corner.

- Here the splicer threads the strands into their new position in the rope. This picture shows the proper distribution of starting tucks. Continuing the even tucking: "eight strands under twice. six strands under three times, then over one and under two"
- 5 Practically finished now—he tightens his splice, and has just a few more tucks to go
- 6 Smoothing the splice preparatory to wrapping with serving wire. A wooden mallet would have been better here, but the guy did pretty well with the tools he had

#### California Woos Junior Engineers with High Starting Salary

Shown herewith is one of several advertisements which have appeared in recent months in the newspapers of larger California cities. This clipping is reproduced by the ROADS AND STREETS editors as one of the best pieces of 'copy' of its kind to come to our attention.

Wondering just what policy-thinking was behind these interesting advertisements, we wrote the California division of highways. Following is statement received in reply from J. G.

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Standley, assistant state highway engineer:

"As you know, there has been a shortage of engineering personnel throughout the nation, and the recent tripling of our construction program, combined with the fact that we were below even our normal requirements due to the war, made it absolutely essential that we acquire the necessary personnel if we were to handle the work.

"During the war years we had approximately 350 qualified engineers in the service on leave, and also, we were unable during that period to recruit young engineering graduates since they were, as a whole, in the



If you have the stuff to make good, you now have the opportunity to-get in on the ground floor of a rapidly expanding organization with excellent chance for promotion.

The California State Division of Highways offers broad training in its very large program of freeway and highway construction. Recent graduate engineers especially wanted with or without experience, who wish to make highway engineering their careers. All phases of highway and traffic engineering including economics, soil mechanics, rights of way, design, location, construction. Starting salary, Junior Civil Engineer, \$310 per month.

California is noted for its Civil

California is noted for its Civil Service standards. Your future de pends on you.

Apply 808 Galifornia State Bldg. Mr. Hughes Phone MA, 1271, Station 369

service themselves.

"At present our efforts are concentrated in picking up recent engineering graduates or young men with an equivalent combination of education and experience. In the last six months, we have employed approximately 200 junior civil engineers, and at the present time have applications from an equivalent number—all of whom we can place. We are offering a starting salary of \$310 a month, and so far our efforts seem to be successful.

"As indicated above, during the war we were unable to contact graduates; however, since then we have renewed the practice, which started in 1928, of visiting the universities and discussing the possibilities of employment, even during the summer months, so as to interest and encourage graduates to take up highway work as a career. This procedure has been very successful not only in recruiting but in obtaining manpower which under our training procedure has been developed and advanced within the organization.

"The beginning salary which we are offering at this time is perhaps a little above the beginning salary which other highway departments are paying, but is dictated by salaries established for other large agencies employing engineering personnel in this vicinity."

Pennsylvania's road program this year will pass the \$100,000,000 mark, the first time in history that one state has invested this much in road improvements. This state will hence be first in rank, with California, New York, and Texas trailing.



NORLO'S LARGEST MANUFACTURERS OF ALL-METAL CLUTCH FACINGS AND BRAKE LININGS

1374 East 51st St . Cleveland 3, Ohio

unit clutches.

# EUCS SURE DO THE JOB!



REAR-DUMP EUCLIDS

CAPACITIES—15 to 30 ton payloads POWER—150 to 275 h.p. diesel engines SPEEDS—Up to 35.4 m.p.h. loaded

BOTTOM-DUMP EUCLIDS

CAPACITIES—13 to 50 cubic yard payloads POWER—150 to 275 h.p. diesel engines SPEEDS—Up to 32.6 m.p.h. loaded Men who know hauling equipment preference Euclids. On mining and construction jobs the world over, you'll hear owners say, "Euclid is the best hauling equipment we've ever used". Operators, too, like "Eucs" because they have plenty of power and are easy to handle.

Euclids have earned their reputation for rugged staying power, low cost production and continuous operation on hundreds of tough jobs. From bumper to bumper every part is designed and constructed for long life in heavy duty off-the-highway hauling. The ability of Euclids to "keep coming back for more" is the reason why owners agree that Euclids really do the job.

The recommendations of a hauling equipment specialist are available without obligation—call or write your Euclid distributor.

The EUCLID ROAD MACHINERY Co:





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# **How Big the Contract Section?**

State highway departments have varied policies, nation-wide survey shows

UST how big should a road job be? When is it a good policy to cut the work into two or more contract sections? What is the range of road job sizes these days?

Realizing that there is quite a diffe ence in the policies of the various state highway departments, and that jos size often has a big bearing on a contractor's unit costs, we questioned state highway department chiefs on the matter.

Many interesting replies were received, showing that in the main the subject of job size is being given serious thought. Following are some of the facts and comments:

New York state has not established any dollar ceiling on its highway contracts. We have, on occasion, divided projects into component parts such as substructure, superstructure and paving of a major bridge structure or grading and paving on a highway project. Such moves have been dictated by a desire to advance the work with minimum delays rather than by any decision to keep individual contracts within a specified cost limitation.—Robert J. Shillinglaw, Public Relations Officer

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Kansas—We seldom let individual projects totaling as much as one-half million dollars, feeling that competition would be limited somewhat if our individual projects were larger than this amount. Frequently on paving projects the amount might run

Federal Aid Road Job Sizes

Listed below are the percentages of the total number of contract awards falling under various categories for the calendar year 1947 and the first four months of 1948, as shown by PRA records supplied by deputy commissioner J. S. Bright.

Size of contracts	% total number of contract awards—	% total number of contract awards— 1948
Under \$ 25,000	27	26
\$ 25,000-\$ 50,000	15	14
\$ 50,000-\$ 100,000	19	21
\$100,000-\$ 250,000	24	24
\$250,000-\$ 500,000	10	9
\$500,000-\$1,000,000	4	4
Over \$1,000,000	1	2
	100%	100%

this high, but if we would have as much as one million dollars worth of work in one continuous project we would cut the project into two or three parts, although we do allow contractors to tie like types of work.

We also seldom have a grading project that would exceed three or four hundred thousand dollars and if the total improvement would cost one-half million or more, we would in general cut it into two parts. We are letting a large number of secondary Federal-aid projects, and such projects that involve grading probably do not average more than \$40,000 each, while on our state highway project our grading projects would probably average from \$100,000 to \$150,000. Stabilized base and mat projects would probably average \$150-200,000.

While we recognize that there might be savings due to letting very large projects to one contractor, we believe that in the long run we gain by allowing more contractors to bid on the projects, and if one large contractor desires to tie a number of projects together in the same letting, he is allowed to do so.—R. C. Keeling, State Highway Engineer

Oregon-The point at which it becomes economical or advantageous to subdivide projects, varies widely and is dependent upon many factors such as kind of work, accessibility of project, necessity for expeditious performance, extent to which contractors in various project-size groups may be tied-up with other contracts, suitability of work for performance with especially large or unusual equipment, etc. We would say, in general, that all projects estimated to cost \$300,000 or more should be studied for possible advantage to be gained by contracting in two or more parts. Occasionally, gain can be made by splitting smaller projects. On the other hand, however, there are occasions when efficiency, expeditious performance and cost saving can be best attained by contracting in units running to and beyond \$1,000,000.

In accordance with the above expressed ideas, we do frequently split projects into two or more units, permitting contractors to bid the two or more units in combination or separately as they may wish.

In the past 2½ years, the contract amounts have averaged \$170,000, the range being \$5,000 to \$937,000. The largest contract was one requiring the use of a large hydraulic dredge, a type of equipment which could be attracted to and be highly efficient on only projects of considerable magnitude.—R. H. Baldock, State Highway Engineer

Missouri—The laws of this state require us to cut all highway work into sections of five miles or less when taking bids. The contractors are allowed to bid on a combination of sections which add up to more than a total of five miles; however, we always reserve the right to award on single sections if that is deemed advisable.

When a large bridge is included, a contract may run into a million dollars or more on a section of less than five miles. We have no policy other than the state law.—C. W. Brown, Chief Engineer

Wyoming-This department does not have a definitely fixed limitation. We do take into account the number of contractors that would possibly be available for the work and their ability to finance and handle the larger contracts. Whether or not they have the necessary equipment to handle the work, of course, is given serious consideration. In our opinion large contracts tend to restrict the competition to only the big outfits and we believe that better bidding is generally obtained when the size of the contract is held down to a reasonable figure.

Our largest post-war contract amounted to approximately \$785,000, but it is seldom that our single contracts exceed \$400,000. Average is \$200,000 to \$300,000.—J. R. Bromley, Superintendent

Pennsylvania—In 1946 we were led to believe that we would have extreme difficulty in finding contractors who would undertake large projects. However, in 1947 and 1948 we have found that our principal contractors gave us better prices on the larger

units than when such projects were divided into smaller contracts.

Below is table showing the bidding trend for the year 1947 and for 1948 from January 1 to May 7, inclusive.

For the Calendar Year 1947, 227 projects were awarded for construction or reconstruction of roads and bridges totaling \$67,736,812, or an average bid price of \$298,400 per project. The size of projects ranged from \$5,290 to \$5,718,495.

From January 1, 1948 to and including May 7, 1948, twelve lettings were held involving 98 projects. Of this number, 92 were awarded for the contract bid price of \$42,684,146, the average bid price or monetary size of project being \$463,958, ranging from \$9,916 to \$3,423,293 per project.

These projects are classified as follows: tract was for \$2,402,104 for an expressway job in Fort Worth, bids taken on Feb. 26, 1948.—D. C. Greer, State Highway Engineer

Michigan—A lot of factors must be taken into account before answering the question of how large a road job should be before it is a good policy to cut it up into two or more contract sections. The type of work, the base of supplies, the possibility of a good detour, whether it is on new right-ofway, and the urgency of the construction are all factors to be considered.

In this state, we try, wherever possible, to place enough quantities in the contract to keep the overhead of moving in and set-up so as not to exceed \$1,000 a mile.

If anything, our contracts have been too short in length and too small in

postwar period when monetary size alone was a deciding consideration. Where a job may be handled either as several small projects or as one large project, we usually take bids individually on the small projects and permit a combination bid on the whole. We then award contracts on whichever basis is most favorable.

An analysis of primary road contracts (size is not a consideration in secondary contracts) awarded since January 1, 1946, shows the following:

Pavement contracts ranged from a low of \$17,080 to a high of \$777,897 and averaged \$222,000, with six individual projects exceeding \$500,000 but with one combination of two projects amounting to \$942,776.

Contracts for bituminous concrete surfaces on existing rigid-type pavements ranged from \$5,600 to 593,348 and averaged \$172,000, with only two exceeding \$500,000.

only two exceeding \$500,000.

Heavy grading contracts ranged from \$4,213 to \$479,794 and averaged \$175,000. One combination award for three individual projects amounted to \$503,470 and another for five projects amounted to \$1,242,452.

Structure contracts ranged from \$8,335 to \$820,716 and averaged \$101,000, with only

\$820,716 and averaged \$101,000, with only one contract exceeding \$500,000. Weighted average of all individual contracts, \$158,000.

None of the larger individual projects on our urban program has yet reached the contract stage, but we anticipate that some of these may exceed one million dollars in contract price.—W. W. Polk, Chief Highway Engineer

W. Virginia—Although we have not set any definite limit as to the size of a contract, we have felt that the smaller jobs have had certain distinct advantages over the large contracts and within the past few years, we have let very few contracts running over a half million dollars each.

In this state many of the large contractors with heavy grading equipment have gone into coal stripping, so that the number of contractors able to handle very large contracts is limited. As a result we have found that we have more bidders and much keener competition on the smaller jobs. Contractors too, even though they are capable of handling very large contracts, seem to be more interested in jobs which they can complete within a limited length of time and this means smaller contracts. Because of the dearth of contractors we have also felt that we should encourage small operators to enter the road contracting business. The letting of small contracts has resulted in the entry into the road contracting business of a number of new companies which of course will grow in size as they are successful. We have also made it a practice to let separately those parts of a project which require different kinds of equipment and organization. For example, we

	No.	Projects	No.	Bidders	per	Project	No. of	Bidders
Bid Price	1947	1948	1947	1948	1947	1948	1947	1948
Under 25,000	10	4	43	19	4.30	4.75	1-13	1-10
25,000 to 50,000	27	6	101	18	3.74	3.00	1- 9	1-4
50,000 to 75,000	26	5	80	. 32	3.08	6.40	1- 7	2-14
75,000 to 100,000	24	6	89	21	3.70	3.50	1-11	2- 6
100,000 to 200,000	53	26	202	109	3.81	4.19	1-10	1-10
200,000 to 300,000	26	9	81	23	3.12	2.56	1-8	1- 5
300,000 to 400,000	14	9	36	24	2.57	2.67	1- 5	1- 6
400,000 to 500,000	10	2	34	9	3.40	4.50	1- 5	4- 5
500,000 to 600,000	6	3	22	10	3,67	3.33	1-10	2-4
600,000 to 700,000	5	5	15	25	3.00	5.00	2- 6	3-8
700,000 to 800,000	5	-	15	manage.	3.00	-	1- 9	
800,000 to 900,000	2	1	8	5	4.00	5.00	31- 5	5
900,000 to 1,000,000	4	2	13	6	3.25	3.00	2- 5	2- 4
1,000,000 to 1,250,000	3	4	10	7	3.33	1.75	3- 4	1- 3
1,250,000 to 1,500,000	6	2	26	10	4.33	5.00	1-8	3- 7
1,500,000 to 2,000,000	4	6	13	30	3.25	5.00	2- 7	1- 9
2,000,000 to 3,000,000	1	1	2	9	2.00	9.00	2	9
Over 3,000,000	1	1	2	7	2.00	7.00	2	7
Total	227	92	792	364	3.49	3.96	1-13	1-14

Texas—90% of our contracts are less than \$300,000 and our average contract cost for 1,088 contracts, is \$147.465.

Frankly, we do not have any definite policy on this matter in Texas. We have a variety of contractors to work with. They vary in size and financial ability, and depending upon the conditions confronting us at the time of a proposed letting, we let the project size fall about where it will. We have been successful in contracting on this basis. By such a spread, we are able to give the small contractors all they would like and also the big contractors large projects to work with.

The smallest contract was in the amount of \$7,092 for single asphalt surface treatment, bids taken on August 19, 1947 and the largest con-

amount of money, averaging somewhere around \$250,000.

On the County Federal Aid Secondary program, we have a very glaring example of small, petty contracts, sometimes only a mile in length and ranging from \$20,000 to \$80,000. These are all right when we have a supply of small contractors, but when a big outfit must bid them they pay an exorbitant price for the moving in of the necessary equipment.—H. C. Coons, Deputy Commissioner-Chief Engineer

Illinois—No definite policy which would limit the size of a single contract. There are a number of other factors which have a bearing on the question of how much work can be handled economically and expediently under a single contract, and we have had very few occasions in the

Highway Contracts Awarded by State Highway Commission of Texas From August, 1945, to May, 1948, Inclusive

Group		Number of Contracts	Accumulated Percentage	Percentage to Total	Amount of Contract	Average Cost per Contract by Groups
50 M & Under 51 M-100 M 101 M-200 M 201 M-300 M 301 M-500 M 501 M-800 M 801 M-1,500 M Over 1,500 M	9	256 339 271 118 62 26 13	23.53 54.70 79.61 90.45 96.15 98.54 99.73 100.00	23.53 31.17 24.91 10.84 5.70 2.39 1.19	\$ 8,552,000 25,360,000 38,643,000 28,784,000 23,276,000 15,221,000 4,486,000 6,120,000	\$ 33,400 74,800 142,600 243,900 375,400 585,400 1,114,300 2,040,000
Totals		1088			\$160,442,000 102.29	\$ 147,465

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generally let the grading separate from paving and from bridges. This also reduces the size of a contract and decreases the amount of subcontracting.—M. L. O'Neale, Chief Engineer

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Arkansas-We have no fixed rule for determining the length of roadway sections to be let under single contract, but are governed by considerations of correlating phases of stage construction, time limitations for completion of stages within a construction season, traffic needs, financia considerations, and other attendan circumstances which preclude the use of fixed rules in determining job sizes. In most cases the spacing of our towns and cities and the lim ts of previous construction gov-. ern: that is, a great many of our towns are spaced at 6 to 12 mile intervals and where the spacing is greater, previous construction has in many cases improved a portion of the intervening distance leaving a comparatively short gap to be filled.

	Miles	Contract Commitment
Average Job	8.247	\$162,030
Largest Contract		
Commitment	15.585	654,114
Greatest length, one job	19.874	313,005
Cmallest Contract		
Commitment	1.289	6,737
Shortest length, one job	0.897	9,901

During the calendar years of 1946 and 1947 this department let to contract 109 road projects with a total length of 898.9 miles and total contract commitments of \$17,661,239. Of these, 33 jobs carried contract commitments of over \$200,000 each and 15 jobs of under \$50,000 each.—A. E. Johnson, Chief Engineer

Ohio—Herewith is a record of the construction projects awarded during 1945, 46, and 47:

Year	Projects	Total	Average Price	Highest Award
1945	138	\$ 8,358,971	\$ 60,575	\$ 422,772,92
1946	215	\$22,968,804	\$106,832	\$1,209,261,37
1947	284	\$32,297,955	\$133,725	\$2,993,758.00

The question as to a policy for the size of construction projects depends on so many influences that I hesitate to mention any specific figures; however, the analysis above will clearly indicate the normal operations of the Highway Department in this regard.

The highest figure for 1947 was for a job advertised in three parts but sold as one contract.—Homer E. Anderson, Chief Engineer, Bureau of Construction

Idaho—This is a large state with plenty of highways needing construction and reconstruction. Our available funds are inadequate to meet the requirements; consequently, projects are small and scattered throughout the State to meet the most urgent needs. Very few of our projects exceed

\$500,000. Local contractors are not equipped to handle more than this size project in one season; consequently, we have more contracts totaling one to two hundred thousand than those of a greater amount. If we do have a contract for more, we generally split it so as to try to complete it in one season.

A large percentage of our projects are reconstruction or betterment jobs and are less than \$100,000. In general, our larger bridge projects are let separately from the roadway construction because there is a limitation on the amount of work a general contractor can sublet to others.—James Reid, Director of Highways

Florida—Size of contracts is dependent upon the type of work involved. Our postwar contracts have ranged from a few thousand dol!ars to as much as \$1,500,000 for a bridge.

Although the size of our contracts depends on the type of work involved, we try to keep each project small enough to encourage competition within a wide range of qualified contractors. In general our highway contracts do not exceed \$750,000, with an average of around \$200,000 each.

—E. C. DeGarmo, State Highway Engineer

New Jersey—We try to prepare contracts so that they average about \$1,000,000, in order that the contractor will be confined to one construction season only, and thus avoid the gamble of going over into the next season. However, since the war we have awarded contracts in excess of \$1,000,000, the maximum being \$1,965,804. This was a paving contract and included one bridge.—Charles M. Noble, State Highway Engineer

Nevada—At the beginning of our postwar program of highway construction this subject was discussed by members of this Department at some length as we had several large projects on the Primary system which could have been cut into two or more contract sections. However, after discussing the problem with members of the local A.G.C. it was decided to call for bids on these projects without reducing their length.

We have come up with the conclusion after three postwar years construction experience that the larger the project the more attractive it is to the contracting agencies. For example, projects three or four miles in length and running below \$100,000 of cost would attract from one to three contractors with bid prices fairly high,

while projects costing from one-half million dollars to \$800,000, which are the largest projects we have in this State, attracted from eight to twelve bidders with bid prices proportionately lower.

Postwar contracts to date have ranged in size from \$64,000 to \$800,-000.—W. T. Holcomb, State Highway Engineer

Montana—This department is now endeavoring to determine the size of the road jobs which will reflect the best bid prices. To date no conclusive determinations have been possible, although in a number of instances the smaller jobs have gone to new contractors, breaking into the field, at reasonably conservative prices.

We do not have any experience in handling truly large jobs, largely because of the fact that the limited road building funds must be expended over such a large area that concentration in any one locality or on any one road is impracticable. The statutes, which divide Montana into twelve financial districts within which highway construction operations must progress concurrently, act also to prevent letting extremely large contracts in any one particular area.

Forty-five postwar primary projects range from \$6,000 to \$562,000 with average \$200,000. Project lengths ran from 0.2 miles to 24 miles, average 7.5 miles.—Scott P. Hart, State Highway Engineer

Oklahoma State law provides that in all cases where the project advertised shall be for the construction of more than 8 miles of road, such advertisement shall provide for bids on sections not to exceed 8 miles as well as the project as a whole.

At the June 22 letting we had a project for 23.8 miles of grade, drain, asphalt stabilized base course and single bituminous surface. The project was advertised in three sections of eight miles or less and contractors were allowed to make their bid on each conditional on receiving the entire project. We have found that such projects are almost always bid as a unit rather than by sections. —H. E. Bailey, Director.

Massachusetts—For many years, the Department had a general policy to keep individual contracts below \$1,000,000 in order to obtain adequate competition. However, with the increase in costs, this figure is undoubtedly too low. I believe that we will have some highway contracts up to \$2,000,000 or possibly somewhat larger. Of course, such a limit does not apply to structures.—William H. Buracker, Commissioner



\* Two truck-mixers depositing concrete for the two spreaders, with a third truck on deck

# Truck Mixers Go Rural





WHILE truck-mounted mixers are commonly used these days for paving in and around urban centers, you don't often see truck mixers placing road slab "way out in the country." But a road job was built with such equipment in this manner during the past summer. It is the 3½-mile paving project on U.S. 40 between Centerville and Brownsville, in southwestern Pennsylvania. There

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Rear view of the concreting operation, showing how trucks drove up alongside. Panels of wire reinforcement were set in the area between the two spreaders

A closer view of truck-delivery into the spreader hopper. Note use of paper under the joint, and concrete deposited to hold joint true as spreaders pass over



Wall Wall



\* Power equipment was used for grading under forms and finishing the subgrade



★ Truck-mounted compressor and spades are trenching for stone subdrain, specified under transverse joints.

The wheel tractor is powering a form pin driver



\* Setting a joint assembly, and making the final finisher pass. Here comes another mixer truck in the distance

wasn't a commercial ready-mix plant within many miles, to our knowledge, but when the R and S editor drove 60 miles south from Pittsburgh to see the job, there the mixer trucks were, delivering to a modern spreading and finishing outfit among the cows and chickens. An equally modern and upto-date batching plant, located near

the center of the job and far from a rail siding, was dry-batching 5½ cu. yd.—two 2¾-yd. shots from the bins—into each truck mixer.

The mixer fleet, consisting of 7 Smith mixers mounted on Autocar trucks, was also new. In fact, virtually the whole outfit was right from the factory, and the job is said to signal the entry into concrete paving work of the Allegheny Asphalt & Paving Co., Inc., a Pittsburgh contractor whose forte in the past has been asphalt and lots of it all over western Pennsylvania. The fact that the trucks might come in handy six or even seven days a week around Pittsburgh, throughout a longer working

★ More details of finishing and curing, which were accomplished with a minimum of labor. Note use of earth to hold curing paper securely down, an important specification detail in Pennsylvania



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★ Fifteen-yard dump trucks brought aggregates on a long haul, building stockpiles without help of a dozer by backing over the crib-supported pile from the high side of the hillside yard



★ Cement being delivered from silo at the rail siding to silo at the yard via 100-bbl. trailers. Mix water was delivered with two big over-the-road gas tankers

season than that commonly possible on a rural road job, may have been a factor in this firm's decision to use this type of equipment.

#### 2300 ft. in 8 Hours

The truck-mounted outfit wasn't expected to equal the yardage that can be laid with a couple of 34-E dual-drum pavers, and we'll leave it to our readers to figure the economic fine points of ready-mix vs. pavers here. But the job was progressing steadily, the crew having worked up gradually to a maximum of 2289 lin. ft. of 9" x 11' slab in 8 hours of mixer delivery, or about 700 cu. yd. per day. This amounted to about 125 loads, or a load about every 4 minutes —a 28-minute round trip for each of the 7 trucks on a two- to three-mile

haul.

The stretch of road involved is a relocation, started early in the war and finally re-let to Ralph Myers Construction Co., Salem, Indiana. Allegheny Asphalt & Paving Co. placed the paving by agent agreement with Myers.

The grade was shaped with a Caterpillar motor grader, followed by a Cleveland formgrader. Form pins were driven by a pin driver, powered from a LeRoi Tractair's motor. An RB power subgrader then made its pass, followed by a pair of workers with air spades which trenched across the grade at intervals of 61½ ft. for a stone subgrade drain, tamped or rolled and covered with paper under each joint to insure drainage and maximum support. A 5-ton Buffalo-

Springfield roller compacted the subgrade. Patented joint assemblies with dowels were then installed with a 1-inpre-molded expansion plate every 8th joint.

The method of placing and finishing concrete was to deposit the concrete into the hopper of a Jaeger spreader and spread by this screwtype machine. The spreader was equipped with a screed extension which struck off at a level 2 in. below top of forms. The crew then set the reinforcing; then followed with a second Jaeger spreader, served by a second truck mixer truck stationed immediately behind the first truck. Usually a third and fourth truck arrived in time to keep the concreting continuously in progress. Trucks looped over the old parallel road and came along the grade (or the completed lane), in the direction of the paving work, thus eliminating backing or time-consuming maneuvering.

A Koehring longitudinal float finisher then made its passes, followed by two men with long-handled straightedges, and finishers with trowel and edger. Paper curing cover was used.

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#### 70-ton Bin

A 70-ton, 3-compartment Blaw-Knox bin was set up on a hillside site adjacent to the new road. Slag of two sizes (1¼-in. and 2½-in. max.) and sand were stockpiled from trucks coming in on the high side of the yard, backing over the leveled or ramped-up pile, and dumping. An Insley ½-yd. and a Lima ¾-yd. clamshell crane handled materials into the



General view of the yard, showing hillside site which was capitalized by the contractor to build stockpile directly with the dump trucks



★ (Above): Army trailer, converted by contractor into a field office. (Below): A friendly argument between concrete inspector

Frank Drozik, James Delahunt, project engineer E. W. Harry and Superintendent G. F. Tiberio. (Right): Three-compartment bin



★ (Left): A Brink's armored money car? No, a contractor-assembled traveling field shop, built into a GMC cab-over-engine truck, complete with lathes inside and a welding unit cantilevered on the

back end. (Center): One of the spray nozzles, required in keeping slag aggregate continuously wet for at least 18 hours prior to use. (Right): Surge tank and electrically controlled pump and valve for supplying mix water up pipe and into truck mixer's tank.

bins. Materials, by the way, were hauled 60 miles from Pittsburgh in big 15-yd.-capacity Autocar trucks equipped with Penn dump bodies.

Mixer trucks came in empty at the lower end of the yard, looped around under the hopper, took on aggregates and water, and picked up the cement under a 300-bbl. Blaw-Knox cement bin on the downhill, out-going leg. A nice arrangement. Mix water was carried in a tank on the truck and added after reaching the paving operation where the mixing was done immediately before depositing. Water for the mix was delivered to the plant via a 4000-gal. gasoline delivery tank truck (Autocar) to an 8000-gal. storage tank alongside the batch plant, from which it was fed by a 34-hp. electric pump to the tank on the mixer truck, via an electrically-controlled metering valve.

Bulk cement was delivered from rail cars via another 300-bbl. Blaw-Knox bin located at the siding, cement being transported with two 100bbl. Freuhauf trailer-type cement carriers equipped with unloading screws.

An interesting detail at the material yard was the use of sprays to keep the slag from drying out, to help insure uniform water content in the mix. Spray nozzles spotted around the stockpiles were fed from a 250-gal. pressure tank.

G. F. Tiberio was superintendent for Allegheny Asphalt & Paving Co., Inc., on this project, which was carried out under the Uniontown division of the Pennsylvania department of highways, S. P. Longstreet, district engineer; William Harry was project engineer, and Paul Groff assistant district construction engineer.

★ Little detail, but important—a hand tool, curved like an edger, used for raking loose particles out of the edged centerline joint and cleaning up the adjacent slab



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### **New Construction Equipment and Materials**

#### 1 Leaf Collector

A new leaf and litter collecting unit has been announced by Good Roads Machinery Corporation, Minerva, O. The collector includes such features as an hydraulic jack under the trailer tongue for facilitating hitching, hydraulic jack under dump



Good Roads Leaf Collector

body for dumping load in less than 1 minute, a special vacuum snout mounted on a free-wheeling tricycle undercarriage for use under and around parked cars, around sharp corners, into driveway entrances, etc., self-contained 40-HP Ford industrial power unit, a suction able to pick up and powder glass bottles, stones, small branches, water soaked leaves, etc. It has a hopper capacity equal to 10 or 12 truck loads of noncompacted leaves plus the ability to travel at speeds up to 60 miles per hour.

#### 2 Sand and Gravel Pump

A new sand and gravel pump developed by Kansas City Hay Press Co., Kansas City, Mo., has front and back side plates secured without bolts which is stated to make disassembly and parts replacement a relatively easy matter. At the same time, the absence of bolt holes in the shell tend to strengthen and lengthen the service life of the shell. The new design makes possible the very close tolerance of 1/64 in, between impeller and suction liner. All wearing parts of the pump are cast of a new alloy called Hi-Chro-Hi, a white, semi-steel. Overhaul of the pump is reported to be reduced to a basically simple operation which can, if necessary, be performed by a layman.

#### 3 Swivel for Wire Rope

An antilar ball bearing swivel designed and developed by General Machine & Welding Works, Pomona, Calif., is claimed to eliminate twist and line unlaying in wire rope. A particularly popular first model is the Miller whip line special. The weight of this swivel (32 lb.) is great enough to return a whip line to the ground when using a long boom. It is stated that even under a 77,000 lb. load, this Miller swivel can be turned by merely



Miller Whip Line Special on Concrete
Bucket

grasping it with the thumb and forefinger. It is constructed of two female ends (clevises). Miller swivel bearings are protected from dirt and water by a heavy, life-time grease packing, sealed when the swivel is assembled at the factory. Assembly

#### For More Facts on These Products

Mail inserted card, and we'll pass your inquiry along.

Or write directly to the manufacturers or their nearest distributors, referring to this issue of Roads and Streets and the equipment mentioned. is made under pressure to force all vacuum pockets from the bearing chambers. The swivels are precision machined of high strength steel in sizes comparable to wire rope (1 in. % in., % in., etc.) and are available in ten different styles (hook and clevis, clevis and eye, swedge and stud, etc.). Miller swivels are cadmium plated to prevent rust and deterioration.

### Trenching Machine

A trencher mounted on a Ferguson tractor driven from the power take-off and raised or lowered by the tractor's hydraulic system, has been placed in production by the Everett Manufacturing Co., Inc., Phoenix, Ariz. The trencher has adjustable clearance teeth and digs from 12 into 18 in. in width. It is possible to dig an additional width trench by extending the wheel width of the Ferguson Tractor. This new trencher can be set to cut any distance down to 42 in. deep, and it travels from 1½ to 5

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**Everett Trencher Hooked to Ferguson Tractor** 

feet a minute depending upon the depth and width of cut and type of soil. It has a special transmission for necessary speed reduction. This can be switched to standard tractor speeds by a handy shifting lever. The Everett Manufacturing Co. has placed the national distribution of its new trencher with The Tractor Sales Corp., Los Angeles, Calif.

#### 5 Traffic Marking Paint

A silicated traffic marking paint, claimed to be more durable and resistant to continual cleaning, is now being manufactured by The Wilbur & Williams Co., Boston, Mass. It is designed for industrial marking off of safety, storage, and traffic areas and has the additional safety feature of preventing slippery hazard. It is applied equally well with brush or line markers.

6 New Tournapull

A new model Tournapull has been added to the line of high-speed earth-noving equipment of R. G. Le-ourneau, Inc., Peoria, Ill. This Model Tournapull is used with the Model 16 Carryall scraper which has a capacity of 13.3 cu. yd. This unit, which is powered by a 150 H.P. 6 cylinder diesel engine, has four forward speeds ranging from 2.19 to 17.3 m.p.h. One of the developments included on the new C Tournapull is electric control of Tournapull steering, scraper bowl, apron and tailgate

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Model C Tournapull with E16 Scraper

by individual electric motors. These Tournatorque electric motors, which were specifically designed and built by LeTourneau to handle heavy construction work, are a new type AC motor with the lugging characteristics of a DC motor. Source of electrical current for these motors is a 240 volt 120 cycle AC generator built in line with the Tournapull engine. A feature of these generators is the revolving field which requires low excitation voltage thus reducing arcing and power loss at the brushes. Steering and scraper operations are controlled through these motors by means of toggle switches on the control panel of the Tournapull. Another feature of the C Tournapull is a constant mesh transmission which gives instantaneous selection of gear ratios without shifting gears or loss of momentum. Conventional foot clutches and gear shifting are eliminated. Gear selection is controlled by a single selector lever. A torque proportioning differential is another LeTourneau development included in this machine. If, when operating in mud, sand or other soft materials, one wheel should start to slip, Tournamatic differential automatically delivers up to four times tractive effort of slipping wheel to the wheel on firmer footing. Overall specifications of the C Tournapull with the E16 Carryall scraper are:

length 31 ft.; height 9 ft. 3 in.; width 11 ft. 4 in.; wheelbase 18 ft. 2 in., and empty weight 29,220 lb.

#### 7 New Concrete Vibrators

A new line of electrically-powered concrete vibrators has been added to gasoline-powered vibrators of the Stow Manufacturing Co., Binghamton, N.Y. Comprising two models, the new vibrators have totally enclosed splash-proof electric motors, water-tight control stations and cable



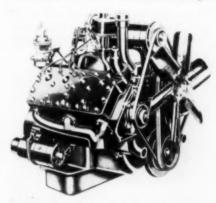
Electrically-Powered Concrete Vibrator

connectors, ball - bearing countershafts that are adjustable for belt tension, and full 360° swivel mountings. The shafts from the motors to the vibrating heads are joined in sections and can be extended to a total length of 35 ft. They are reinforced by flat coils at each end, affording rugged protection under rough usage. Model HE has a speed of 6000 vibrations per minute under full load and a vibrator head 21/2-in. in diameter. It is powered by a 3 hp., 220/440 volt, 60 cycle, 3 phase motor, and comes equipped with two 7-ft. vibrator shaft sections. Model JE6 has a speed of 7600 vibrations per minute at full load. It is powered by a 11/2 hp., 110/220 volt, 60 cycle, single phase motor, has 11/2-in diameter vibrator head and two 8-ft. sections of vibrator shaft. Either of the models can be mounted on a rubber tired wheelbarrow.

> 8 New Engines

Five new power plants for the industrial engine field now in production by the Ford Motor Co., Dearborn, Mich., are stated to be particularly adapted for the operation of such construction equipment as cranes, shovels, pavers, pumps, winches, hoists, sweepers, oilers, concrete mixers, and for other special purposes. The new models are the 337 and 239 V-8's; the 254 and 226 sixcylinder, and the 120 four-cylinder. The numerical designation indicates cubic inches of piston displacement in all cases. The 337 V-8 bore and stroke is 31/2 in. x 41/8 in., and compression ratio, 6.5 to 1. It develops 258 footpounds torque and has proportionate high horsepower output. Hard faced cobalt chrome alloy steel exhaust

valves and molybdenum chrome alloy valve seats with chrome nickel alloy intake valves provide maximum valve life in heavy duty service under sustained loads. The 254 six-cylinder engine bore and stroke is 31/2 in. x 4.4 in., and compression ratio 6.7 to 1. It develops 211 foot-pounds torque. Hard faced chrome cobalt exhaust valves, chrome rings and triple layer copper lead alloy bearings are standard equipment. The 239 V-8 engine has bore and stroke of 3-3/16 in. x 3% in.; compression ratio 6.8 to 1, developing 187 foot-pounds torque and comparable horsepower. The bore and stroke of the 226 six-cylinder engine is 3.3 in. x 4.4 in., and compression ratio 6.7 to 1. Maximum torque



Ford Model 337 V-8 Industrial Engine

is 183 foot-pounds. The crankshaft is of Ford alloy steel. Triple layer copper alloy bearings are steel backed. The Ford 120 four-cylinder engine has a 6.5 to 1 compression ratio and 3-3/16 in. x 3% in. bore and stroke. Cylinder sleeves are removable dry liners. The crankshaft is of Ford alloy steel, statically and dynamically balanced. A variable speed, mechanical governor is gear-driven. It develops a maximum of 84 footpounds torque. All engines are available with SAE housings so that standard heavy duty clutches and power takeoffs can be used. Three, four, and five-speed heavy duty transmissions are also available on Ford industrial engines.

#### 9 Swivel Connection for Hose

A new swivel connection that eliminates twisting and kinking of hose carrying air, water, hydraulics, etc., has been perfected and patented by Dixon Valve & Coupling Co., Philadelphia, Pa. Construction consists of only two metal parts and a rubber or synthetic gasket. Responding freely to every turning motion of the hose, it is stated to remain absolutely leakproof under all normal working pressures. Sealing is effected by the gasket, which is designed to expand as increasing pressure is applied. The unit

is compact, durable, light in weight, with a full-flow orifice providing maximum capacity. It requires no lubrication or adjustment. Time saved in straightening out kinked and twisted hose lines, and protection for the hose against torsional strain, are among the important advantages claimed for this new connection. Now available in ½ in. and ¾ in. I.P.T. sizes, in cadmium plated steel.

#### 10 6-9 Ton Roller

A 6-9 ton roller has been added to the Pierce Bear roller line of Lewis Manufacturing Co., San Antonio, Tex. The compression roll is 50 in. diameter by 50 in. wide. The guiding roll is approximately 40 in. diameter by 44 in. width. Wheel base is approximately 65 in., length over-all



Williams Metal Rustrication Joint

to the line of concrete form hardware of Williams Form Engineering Corporation, Grand Rapids, Mich. Rustication joints are required on architectural concrete structures, mainly as a method of "dressing-up" the concrete. Normally, these are formed in wood, in which case they are seldom reuseable. It is claimed that by using a metal interlocking section, these are not only reuseable, but save labor in placing, and when oiled with a sticky type oil, are more easily removed and with less danger of breaking the corporation.

The circuit has a fixed turn-off delay of approximately 15 seconds to prevent cycling due to lightning flashes, rotating aircraft beacons, or similar transients. The circuit has adequate fuse protection.

#### 13 Pavement Breaker

A new gasoline pavement breaker and rock drill, Model H-6B, has been announced by Barco Manufacturing Co., Chicago, Ill. It was developed to provide increased capacity to speed up production under average conditions. A six-volt storage battery of the ordinary automobile type is recommended for carrying ignition to the Hammer, where recharging facilities are available. Otherwise, a nine volt dry cell battery may be substituted. Operating expense is stated to amount to only a few cents an hour. This includes fuel consumption of one quart per hour of mixture of gasoline and oil, replacement of piston spring when it becomes too short for effective use, and recharging of storage battery or replacement of dry battery.

#### 14 New FWD Model ZU

Clintonville, Wisconsin: A new model in the FWD line of heavy-duty four and six-wheel drive trucks was announced recently by The Four Wheel Drive Auto Co. Rated at 33,000 lb. gross vehicle weight, the truck is newly designed and newly engineered throughout.

Embodied in the new ZU are entirely new features in advanced automotive engineering and design. The new ZU is the first in the FWD line to feature the new FWD all steel cab which provides 30% greater visibility and increased driver comfort. A handy glove compartment is located immediately above the windshield. Advance design heat and ventilation control provides for comfort during either hot or cold weather.

The newly designed FWD "S" type constant mesh transmission with helical gears and easy sliding jaw clutches for easy shifting and quiet operation is provided in the ZU. Of special interest to truck operators is the new vacuum operated center differential control lock. A finger tip control lever locks or unlocks the exclusive FWD free-acting center differential. A red indicator light located directly over the switch glows red while the differential is locked and switches off when the center differential is unlocked.

The new Model ZU is powered by the 140-GZ, 554 cubic inch high compression gasoline engine. The engine develops 188 horsepower at 2,600



Three Rollers of Pierce Bear Family

168 % in., and width over-all 60 in. Compression roll without ballast 160 lb. per lineal inch; with full water ballast approximately 235 lb. per lineal inch. The curb clearance is 33 in. The speed is approximately 1.85 miles in low and 3 miles per hour in high (engine governed at 1400 rpm). The accompanying illustration shows the three members of the Bear family, the new 6-9 ton roller being at the right. The 21/4-3 ton roller is at the left and the 4-5 ton roller in the center. All three of these tandem rollers are variable weight, desired weight being reached by adding water to the rolls. The 21/2-3 ton Baby Bear comes equipped with an electrical starting system and gasoline engine. The two larger models also have the electrical starting system as standard equipment and can be furnished with either gasoline or diesel power. One of the outstanding features claimed for these rollers is the extremely high curb clearance on all three models permitting operating between forms or obstructions with ease. Another feature is that of being able to roll very close to a building or wall surface, eliminating much expensive hand tamping.

#### 11 Metal Rustication Joint

A metal rustication joint planned to prevent corrosion has been added

#### 12 New Street Lighting Control

A new series of photoelectric street lighting control announced by Fisher-Pierce Co., Inc., Dept. 43, 70 Ceylon St., Boston 21, Mass., has a capacity of 3,000 watts of incandescent lamp load. Models are available for both 120 and 230 volts 50-60 cycles. The unit is designed to control all types of outdoor lighting. Lights are controlled according to preset values of daylight intensity. The standard turnon adjustment is 0.5 foot-candles with turn-off at 1.25 foot candles. Pro-



Complete Control

vision is made for adjustment of the turn-on from 0.5 to 4 foot-candles. The turn-off will remain approximately 0.75 foot-candles higher than the turn-on.

The control is designed to be "fail safe," leaving the lights turned on.

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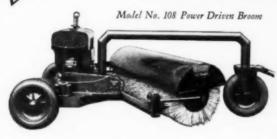
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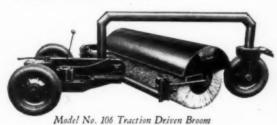




GIVE ADJUSTABLE **BRUSH TENSION** 



Before applying Asphalt, Tar, Road Oils or Emulsions, a Littleford Road Broom will put the road in shape. Either the Power Driven or Traction Driven Broom will rid the road of dust or dirt in one sweep. Both these Littleford models are two-way brooms, will sweep to the right or left and can be changed from right to left or left to right in 10 seconds time. The Littleford Hydraulic raising and lowering system regulates the tension of the brush on the road surface—this saves wear on the brush, cuts the cost of brush replacements. For economy and efficiency in Highway Sweeping, the Littleford Model 106 Traction Driven or Model 108 Power Driven is the answer. Both models can be equipped with Sprinkler Systems and Model 108 can be equipped with a Swivel Dust Blower Attachment. Write for Bulletin No. 19.



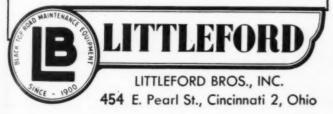
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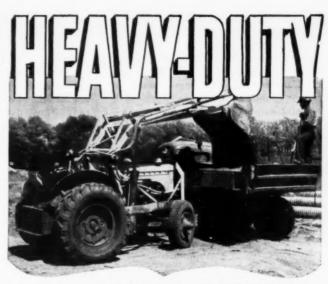
"Spray Master" Pressure Distributors

"Tankar" Steam Heaters "Kwik-Melter" Roofers Kettles Trail-O-Rollers

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**Asphalt Supply Tanks** No. 101 Utility Spray Tanks 84-HD Asphalt Kettles





#### from RADIATOR to DRAWBAR



A complete line of attachments and uni-

formly high performance qualify MM Industrial Tractors for a wide variety of construction and maintenance jobs. Special heavy construction of each part makes them toughest built from radiator to drawbar for longer service on the job with minimum maintenance.

MODERN MACHINERY

To make them the easiest handling industrial tractors for their capacity, MM design employs the Ross steering gear and anti-friction bearings at important points, as well as high capacity front axle and tires.

See your MM Dealer-Distributor or write

#### NEAPOLIS-MOL POWER IMPLEMENT COMPANY MINNEAPOLIS 1, MINNESOTA

R.P.M. governed speed and 460 foot pounds of torque at 1000 R.P.M. All engine accessories are located to provide easy adjustment.

The Four Wheel Drive Auto Company recommends the new Model ZU for use by highway departments in year 'round maintenance work with special emphasis on heavy-duty snow removal. It is also recommended for oil field hauling, logging and lumber hauling, contractor hauling and for use with transit concrete mixers.

#### 15

#### **New Mack Tractor**

A new 45,000-lb, basic gross-combination-weight tractor, powered by the



Model EQT Mack Tractor

Thermodyne engine and offering the exclusive mono-shift transmission, announced by Mack Manufacturing Corporation, Long Island City, N.Y., was designed specifically for high-speed tractor operations where exceptional

gradeability and overall high performance are demanded. Outstanding feature of this model EQT is a new 431-cu.-in. Thermodyne engine. The design of the new engine is identical with the larger Thermodynes used in the heaviest Mack highway vehicles. At its governed r.p.m. of 2500 the new engine develops 139 h.p. It has the exceptionally high torque output of 330 foot-pounds at 1400 r.p.m. Linking the engine to the transmission is a 13%-in. diameter, singleplate dry clutch with an engagement area of 202 sq. in. The EQT offers a choice of two Mack-built transmissions, both matched to the new Thermodyne engine. Standard is the Mack TR-311 5-speed, direct-in-fifth transmission. The Mono-Shift TRD-313 duplex transmission, offering ten speeds in ideal graduations, controlled by a single gear-shift lever, is available as an optional extra. With the Mono-Shift, compound shifts in either direction may be made simultaneously with main-box shifts. Pre-selection of the compound ratios is also a feature. In all cases the shift can be accomplished swiftly, silently and positively.

#### 16 New Engine

A new engine, the H-540, announced by Le Roi Co., Milwaukee, Wis., is a V-8, valve-in-head unit pro-

viding extreme flexibility with speeds up to 1800 R.P.M. Designed to meet high speed requirements, the new H-540 engine provides smooth power

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Le Roi H-540 Unit

throughout the speed range with conservatively rated horsepowers up to 135. The H-540 is compact, easily accessible and light in weight despite the horsepower range. The H-540 runs on gasoline, butane or natural gas, a feature common to all Le Roi engines. Features incorporated in the new Le Roi H-540 engine are removable, wet-type cylinder sleeves; extraheavy, counterweighted crankshaft; unit construction of crankcase and

# FOR YEAR AROUND TRACTOR OPERATION WITH HORN-DRAULIC INDUSTRIAL LOADERS

MANUFACTURED BY THE WORLD'S LARGEST MANUFACTURERS OF HYDRAULIC LOADERS



#### FORD

Streamlined and compact the Horn-Draulic Industrial Loader performs the year 'round leveling, filling and leveling jeb with ease. Let your small equipment do double duty.

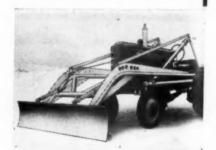


#### CASE VAI

The twin cylinder operation lifts 1,690 pounds with ease, Easily installed and maintained. A sturdy, balanced unit of proven design.

Write for complete specifications and engineering data on this outstanding Industrial Loader for your Ford, Case VAI and Jehn Deere M Tractors. There is a representative in your locality.

A TWIN CYLINDER HYDRAULIC LOADER DESIGNED FOR SERVICE



#### JOHN DEERE M

Engineered to distribute the load over the Loader frame. Tractor does not carry the strain. Check this labor saving, time saving loader today!

WRITE FOR DETAILS

### HORN MANUFACTURING COMPANY

INDUSTRIAL DIVISION

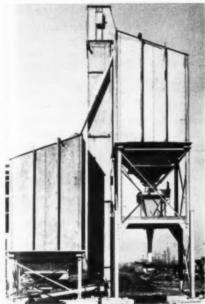
1000 NATIONAL BANK BLDG.

DAVENPORT, IOWA

speeds eylinder block; water-cooled manimeet folds; full-pressure lubrication; gearew Hdriven water pump; modern campower round aluminum pistons; and pushbutton electric starting.

#### 17 **New Cement Batching Plant**

Commercial production has been started by Blaw-Knox Co., Pittsburgh, I'a., on its newly developed portable talk cement batching plant featuring improved portability and the use of an auxiliary bin. This auxiliary bin permits easy and economical expans on of capacity. An undertrack screw feeder, 20 ft. 6 in. from hopper bottom to elevator, enables either the



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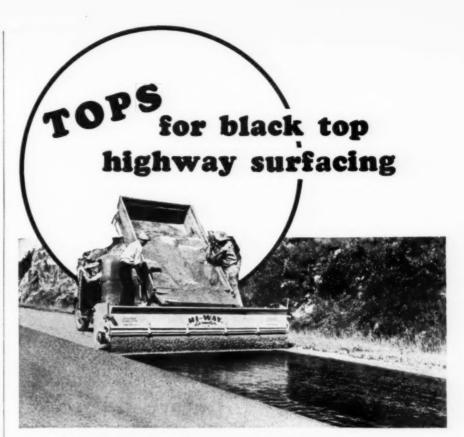
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Blaw-Knox Portable Cement Plant with Auxiliary Bin

immediate or eventual installation of a low-level auxiliary bin on the car unloading side of the elevator. An overflow chute passes cement from the main or batching bin to the auxiliary bin, and the latter has a slide gate for passing material to the screw feeder and thence by elevator to the main bin. The plant has been arranged for utmost portability and speed of erection or dismantling. The entire bin section is a one-piece welded assembly. The cement weighing batcher is supported from the steel platform framing of the middle unit, which is also shipped and erected in one piece. A vertical enclosed type bucket elevator rated at 50 tons per hour and a 9-in. screw feeder serve the plant. Auxiliary and main bins are of the same design and are furnished either in 200-bbl. or 400-bbl. sizes, with total plant storage capacities of 200, 400, 600 or 800 bbl. As a result of the design, it is possible to erect a 200-bbl. main bin with long screw feeder and provide for eventual expansion to 400 or 600 bbl. through



The Hi-Way Model "R" Material Spreader—Traction Driven

Save time, labor and material with the Hi-Way Model "R". Fast, accurate operation. Spreads chips, rock, gravel smoothly -no thick and thin spots to waste time and material. Ideal for seal coats on oil. Operates forward or reverse simply by shifting lever. Adjustable feed gate controls thickness of spread, width is adjusted from one foot to full width of spreader. Entire unit balanced for quick, easy hook-up to truck. Available in 6 widths from 8 to 13 ft.

#### MODEL "DD" SPREADER-MOTOR DRIVEN

Clamps onto tailgate of any dump truck. Handles sand and cinders for ice control, calcium chloride for dust control, equally adapted for seal coat work. Does the work of 5 men costing by hand. 11/2 H.P. Briggs and Stratton power.



WRITE FOR COMPLETE DETAILS

### HIGHWAY EQUIPMENT COMPANY, INC.

605 D AVENUE N.W.

CEDAR RAPIDS, IOWA

SOLD AND SERVICED BY

LEADING CONSTRUCTION MACHINERY DEALERS THROUGHOUT THE UNITED STATES. CANADA AND FOREIGN COUNTRIES.

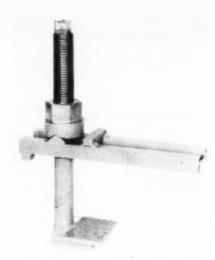
MANUFACTURERS OF THE WORLD'S MOST COMPLETE LINE OF SPREADERS

the addition of the appropriate auxiliary bin. An initial 400-bbl, plant may likewise be expanded to 600 or 800 bbl. in total storage capacity through the installation of a 200 or 400-bbl. auxiliary bin, as the case may be.

#### 18 New Jack for Raising Concrete Slabs

A jack designed to correct slab deflection in concrete pavements has been produced by Templeton, Kenly & Co., Chicago, Ill. Holes are drilled along the crack, spaced at 2-ft. centers. A series of jacks is inserted in these holes to the bottom of the slab.

The draw bar pull to level the lowered slab works on the top surface of the high side and the lower surface of the depressed slab. The pull is taken by degrees, progressively on each jack, until the slab is thus gradually restored to position. Jacks of another type are also used on the shoulder edge and are likewise moved upward by degrees. Alternate jacks in the transverse opening are then removed and the subgrade under the lifted slab is hosed. A Mud-Jack with aggregate nozzle attachment is then used to pump the aggregate under the slab to fill the cavity completely. The mud-jacked aggregate, not having to lift the slab, finds no resistance to its penetration to the farthest points



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Simplex Concrete Slab Leveling Jack

under the slab. The remaining jacks are removed after the concrete under the slab has semi-set and the holes are filled with the same aggregate to their top level, thus completing the job.

#### 19 Transporter for Spreader Boxes

A transporter for heavy stone or chip spreader boxes on which 9 to 12 ft. boxes can be trailed at full speed behind any light pick-up truck has been announced by The Highway Special Equipment Co., Hilliards, O. Only one man is needed to place the trans-



Safety—Easy Transporter

porter over a spreader box. Then, using the worm gear crank on the transporter, he easily hoists the box on two lifting hooks and further secures it with a chain sling, tightened by turnbuckle. The front end of the box bolts to the rigid drawbar for traveling. Loading is accomplished in less than 1½ minutes. Unloading is equally simple. The unit is only 69 in. wide, hub to hub.

#### 20 New Walking Dragline

A new model in its line of walking draglines has just been announced by Bucyrus-Erie Co., South Milwaukee, Wis. Called the 450-W, the new machine incorporates design features developed in the manufacture of thousands of successful earth-moving machines. It is said to have been engineered for the jobs where profitable operation requires sustained delivery

Marion On the Job Besign

### **CUTS COST ON LONG HAULS**

Marion's field-experienced engineers have designed bigger pay loads into trailer dump units. These popular Marion dumps are available in all sizes, furnished with double arm and telescopic hoist. They are designed under actual work conditions to stand up under the toughest hauling and dumping jobs. For literature and prices, write direct or to your nearest Marion Distributor.



MARION
DUMP BODIES and
HYDRAULIC HOISTS

MARION METAL PRODUCTS CO.

MARION, OHIO

of big yardages day-in and day-out. According to the manufacturer, the following 450-W features help insure top output and performance in the field: Weights and loads are balanced so that the center of gravity shifts through a limited range, keeping base rim pressures low. Exclusive Bucyrus-Erie rolling cam walking action permits walking in any direction to positions most effective for dig-Large area base and shoes,



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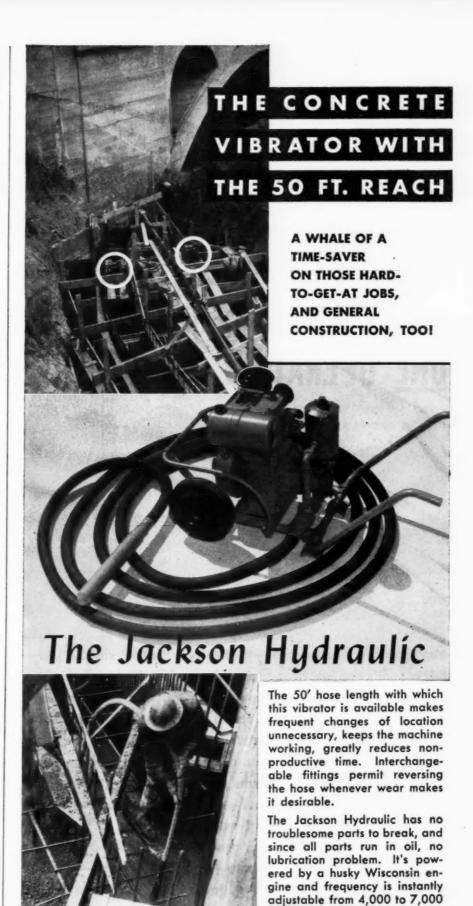
New 450-W Walker

coupled with proper weight distribution, make possible walking and working on soft ground, in all kinds of weather. The 450-W swings 8- to 10-cu. yd. buckets from 200-to 165ft. booms. With an 8-yd. bucket and 200-ft. boom, it can move material 407 ft. without throwing bucket. Heavy-duty diesel engine provides proper power characteristics for highspeed digging and quick, easy moving. Hoisting and lowering are through air-operated clutches and brakes. Swing machinery is under Ward-Leonard variable-voltage control. Responsive controls coordinate digging, hoisting, swinging, and moving . . . are easy on the operator.

## Improved Hough Payloaders

Important improvements in their Model HA 10 1/2 - cu. ft. Payloader and their Model HL 14-cu. yd. Payloader have been announced by Frank G. Hough Co., 801-D Sunnyside Ave., Libertyville, Ill. The chief improvement consists of the addition of hydraulic bucket control as standard equipment. This control dumps and closes the bucket by hydraulic power. Bucket can be dumped gradually or abruptly as desired by fingertip con-





ELECTRIC TAMPER & EQUIPMENT COMPANY ... Improved Hough Payloader

Ludington, Mich.

VPM. Let us send you the com-

plete facts on this finest of all

vibrators for general construc-

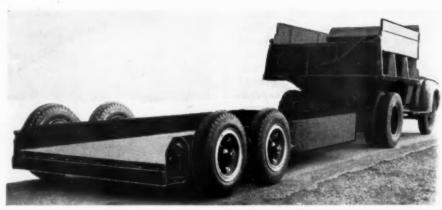
tion purposes.

trol and can be closed immediately by the same control. Advantages claimed for this feature are ease and speed of operation because the bucket need not be grounded and dragged to close it, trucks or other vehicles are relieved of load-dumping shock, wear and tear . . . portions of the bucket load can be deposited in two or more places.

#### 22

#### Low Bed Trailer

A low bed trailer that requires no special prime mover (any truck on the job will serve) is now in production by Alfred Stauffer Machine Shops,



Honey Brook, Pa. Two standard models are available: a 6-ton 2-wheel unit and a 10-ton 4-wheel unit. In both of

#### Model-A-10 10-Ton Trailer

these units the height of bed above ground is 14 in. The standard equipment includes vacuum or air hydraulis brakes, breakaway cables and all necessary lighting. The approximate weight of the 6-ton unit is 3,650 lb; the 10-ton, 5,245 lb. The width overall for both models is 8 ft.; the width of bed is 6 ft. 4 in. The length overall for the 6-ton is 17 ft. 4 in.; 10 tor, 19 ft. 4 in.; and the length of bed is 14 ft. and 16 ft. The loading area is 88 sq. ft. for the 6-ton and 101 sq. ft. for the 10-ton.

#### 23 New Pavement Impactor

An impactor weighing 230 lb. and claimed to hit a series of 1750 to 2000 blows of 717 lb. impact each minute has been produced by Wayer Impactor, Inc., Columbus, O. The impactor and finishing shoe, heated by engine exhaust, is stated to successfully finish any bituminous material and can be used at below



Wayer Impactor

freezing temperatures. It is offered for widening work, street and road repairs, paving driveways, parking lots and factory floors and tamping earth and gravel. Its small size and weight permit the impactor to be transported in a light truck or station wagon to work. A common laborer operates it, permitting the ma-

# MUD-JACKING IS REDUCED TO ONE OPERATION with BITUCOTE



Mud-jacking has become—not only a single, simple job—but also it's the last time that slab needs to be leveled when it's properly done with non-volatile, safe Bitucote asphalt emulsion... It's used unheated and it's non-hazardous.

Added to the slurry, pressure-pumped under the slab, it cures and dries there as a permanent, stable, water-resistant sub-base that forms its own seal right to the top surface of the slab. This seal—plus stability and resistance to impact and compression—stops pumping.

Mud-jacking takes on greater practicability, safety and importance with Bitucote - stabilized slurry—and it's economical and time-saving, too.



Send for Bitucote improved procedure for one-operation mud-jacking.

Bet more of the advantages of asphalt with kitucote Emulsion!

1411 CENTRAL INDUSTRIAL DRIVE . ST. LOUIS 10, MO. Plants in: Cincinnati, O. . St. Louis, Mo. . El Dorado, Ark

chine to travel forward under its own power and merely pulling it back onto its rubber tired transportation wheels whenever it is necessary to stop, turn or move around the job. Its Wisconsin Model AB engine uses from 1 to 1½ gal. of gasoline in day's operation.

24 Backfill Blade on Compressor

A recent addition to the Model 60 crawler type compressor of Schramm Inc., West Chester, Pa., is a hydraulcally operated backfill blade. The

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Backfield Blade on Schramm Compressor

blade is operated by hydraulic pressure, supplied by a hydraulic pump. The pump is a self-contained unit with pressure relief valve, hydraulic reser-

voir and pump are in one housing. Two hydraulically operated cylinders, mounted on track guards, move the blade up and down, traveling 14 in. above ground level and 11 in. below ground level. The blade is useful for backfilling ditches when used in conjunction with a pneumatic backfill tampar and for light grading.

#### 25

**New Staging for High Work** 

A new light weight power-driven staging unit, reported to effect large savings in the man-hours required in painting bridges, sand blasting, etc., has been placed on the market by Spider Staging, Inc., Renton, Wash. The stage itself is constructed of aluminum alloy, with a double guard rail completely surrounding the operator. In use, the stage is suspended on an extra flexible wire rope which winds on a power-driven drum beneath the platform of the unit. Power unit consists of a totally enclosed 172 to 1 reduction gear driven by a standard 1/3 h.p. capacitor type electric motor. Operator controls the stage by means of a standard Cutler-Hammer three - button reversing switch and can ascend or descend vertical drops of up to 650 ft., at an average speed of 18 ft. per minute.



Spider Staging on Painting Job

Two Spider stagings can be joined with a connecting platform to make a power-driven swing stage.

#### 26 New Concrete Bucket

A new round-type concrete bucket of medium weight, for crane elevation on jobs with high walls or where forms cover a wide area, has been introduced by Muller Machinery Co., Metuchen, N.J. It is made of heavy steel plate and is welded throughout,

# Save Money with YAUN

Yes, YAUN saves you money. Every bucket is engineered to give years of faithful, profitable service. All welded construction, perfect balance and the satisfaction of thousands of users are your guarantee that YAUN does the job right. If you haven't become familiar with YAUN'S buckets, ask your dealer.



Perforated Model



Basket Type



Shell Type



YAUR

DRAGLINE BUCKETS AND MFG. PLANT

BATON ROUGE, LA.

Write for folder

When writing advertisers please mention ROADS AND STREETS, September, 1948

107

with steel bar reinforcement around the top and bottom. The discharge opening is 14 in. square and is closed by a double-acting steel-plate gate, designed to stand up in hard service and to close tightly for preventing the leakage of grout. The gate is operated by a convenient curved-pipe

# FLINK SPREADERS



Unquestionably the finest bydraulic spreader.

Hundreds more transportation companies, cities and counties are using Flink Spreaders to spread granulars in ice control and highway maintenance work. Spread forward or backing up, full or half width of street. Controlled from cab. Write for literature.

FLINK CO.

Dept. S-10 Streator, Ill.



New Concrete Bucket

handle. A large reinforced eye permits quick suspension on a crane hook. Capacity 27 cu. ft. of concrete. Height 63 in., diameter 55 in.

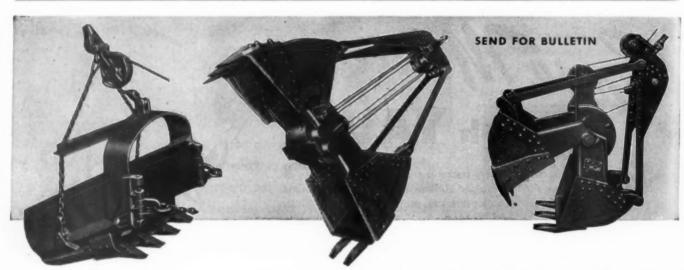
# MANUFACTURERS' LITERATURE

27 Diesel Engines

A book, "Hercules Diesel Engines —General Information" has been published by Hercules Motors Corporation, Canton, O. Among some of the things discussed in detail are: the fundamentals of diesel power and its advantages; Hercules diesel engine construction with enlightening sectional illustrations; a treatise on the patented Hercules combustion chamber and a detailed description of how it functions; the operation of the four cycle engine with functional charts and diagrams; and a discussion of fuel injection equipment and governors. On pages 18 and 19 cold engine starting is given considerable attention while page 20 starts an analysis of the merits of the various types of starting equipment. Neither has fuel oil or lubrication been overlooked. These vital subjects are discussed fully starting on page 23.

#### 28 Soil Cement Processing Methods

A non-technical discussion on the processing of soil-cement with the Seaman Pulvi-Mixer is given in a bulletin prepared by George N. Lamb and issued by Seaman Motors, Inc., Milwaukee, Wis. It is intended primarily for the man on the job but applies as well for the contractor, the paving official and as a ready reference on processing. The text de-



For Longer Life!
WELLMAN
Williams Type BUCKETS

• Count on longer life and more efficient service ... due to Wellman original welded rolled steel construction. You get the maximum digging power, and exceptional strength—without excessive weight! Specify Wellman, and you'll specify the best bucket for your purpose.

THE WELLMAN ENGINEERING COMPANY
7003 CENTRAL AVENUE CLEVELAND 4, OHIO

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scribes the mixing action of the Pulvi-Mixer, its several recent improvements and its adaptation and application to soil-cement construction. Stress is laid on the importance of detailed preparation of the soil bed and of having equipment in adjustment and readiness before actual processing starts. The economy and advantages of scheduling each round rip of Pulvi-Mixers and moistening equipment and of avoiding all hit-andniss movements during actual mixing s strongly emphasized. The bulletin ells how to reduce mixing time and vaporation losses, both of which acomplishments are so essential to fficient mixing and to conserving the all strength of the cement. The disussion of mixing is followed by a brief summation of approved methods of compaction and finishing. The "whys" of all statements are given.

#### 29 Slings

Their newest 9-part ultra-flexible wire rope sling is fully described and illustrated in a bulletin issued by Union Wire Rope Corporation, Kansas City, Mo. The bulletin describes the sling in detail, shows photographs of Tuffy slings being used in various operations, and furnishes charts of safe working loads for angular pulling and angles at which Tuffy slings operate most efficiently. Information on ordering and tables of standard eye sizes are also included.

#### 30 Safety Rules

A list of 15 sensible, but often overlooked, safety rules for unloading railroad boxcars has been compiled by the Clay Sewer Pipe Association, Inc., Columbus, O. The list concerns itself principally with the unloading of vitrified clay pipe, but is readily adaptable to the unloading of any heavy object or material. Four basic rules concern personal safety, and 11 rules are concerned with the care of the ware. The safety rules are printed on a single side of 8 1/2 x 11 in. sheets and could be fixed to bulletin boards or attached to the walls of the receiving department as a constant reminder.

#### 31

#### Welding

A 4-page bulletin stressing low heat welding repairs of automotive equipment has been issued by Eutectic Welding Alloys Corporation, New York. This publication is the first of a series of new circulars entitled "Jim's Eutectips." It is planned to issue this helpful bulletin bimonthly





# Handle Material Faster and Cheaper

with a

#### SAUERMAN 1-MAN MACHINE





(View at Left) Sauerman Tautline Cableway of simple type is sole means of transport across river in South America. Handles thousands of tons of supplies yearly. (View at right) Sauerman Tower Machine digs basin 1250 ft. long for sewage plant; loads spoil into cars at rate of 200 cu. yd. an hour.

SPEED is the great need of these busy times and that is what you are assured when you use a Sauerman Cableway or Scraper machine for your long haul material-handling work.

A Sauerman machine can be installed to reach across a pit, pond, river or stockpile or up to the top of a hill and will move material at high speed from one point to another anywhere within its wide radius. The operation is smooth and flexible; requires relatively little power.

Sauerman machines are backed by 40 years of experience in designing this type of equipment. Whether you wish to handle a few hundred or many thousand cubic yards per day, we give you a machine that will be economical and easily operated by one man.

# SAUERMAN BROS., Inc.

-588 S. Clinton St., Chicago 7-



The SISALKRAFT Method gives you time and labor-saving advantages that cut your curing costs in half! Years of experience and research have developed improved application techniques. SISALKRAFT now is ready with new efficiency and new low costs for your paving season this year!



WRITE FOR THE NEW SISALKRAFT ROAD BOOK

It contains data you will value.

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CITY, ZONE and STATE

THE SISALKRAFT CO.
Chicago 6 · New York 17 · San Francisco 5

and assist welders in various phases of industrial welding repairs. Those interested may be placed on the mailing list of "Jim's Eutectips" by writing to Eutectic Welding Alloys Corporation, 40 Worth Street, New York 13, New York. This new publication contains ideas on how to improve your welding, prize-winning stories on various types of automotive repair with extensive illustrations and complete chart for selection of the 15 most popular welding rods for everyday use. Another feature of the brochure is the cutting tool for all metals, Cuttrode, which can be used with AC-DC and requires no special equipment.

#### 32 Dumpcrete Body

A new illustrated pamphlet showing the use of the Dumpcrete body by contractors for hauling concrete without agitation, has been announced by the Dumpcrete Division of Maxon Construction Co., Inc., Dayton, O. Action pictures show the Dumpcrete in use on highway, bridge, power plant, public works and industrial projects.

#### 33 Motor Grader

A 24-page catalog on its new No. 116 extra heavy-duty motor is now ready for distribution by Galion Iron Works & Mfg. Co., Galion, O. The manufacturer emphasizes that standard equipment includes manual steering with hydraulic booster, same size tires front and rear, and electric starter. With its increased weight, 100 h.p. Diesel engine, all-gear tandem drive, full hydraulic control, and six 14:00 x 24 tires, this grader is claimed to offer the utmost in tractive effort, blade pressure, ease of handling and versatility of blading operations. The many outstanding features of design, construction, and operation are fully illustrated and described.

# HEADQUARTERS for REPAIRS - any make

We will buy or trade in old Transits, Levels, Alidades, etc. Send instruments for valuation.

Write for new Catalogue RS-49, of Engineering Instruments, Engineering Field Equipment and Drafting Room Supplies.

# WARREN-KNIGHT CO. Mfgrs. of Sterling Transits & Levels 136 N. 12th St. • Philadelphia, Pa





#### CUT LABOR COSTS

One MAN riding a MIGHTY MIDGET breaks 100 linear feet per hour of 18" wide trench opening in 6" concrete pavement and cuts a beautifully straight line. MIDGET is supplied with air from 105 C.F.M. compressor. Write for complete information and your dealer's name.

MM-1

R.P.B. CORPORATION

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#### 34 **Dial Scales**

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Six new 3-color technical bulletinstotaling 68 pages of data, diagrams, selection advice, and practical applicat on information on dial scales-have been published by the Yale & Towne Mfg. Co., Philadelphia Division, Philadelphia 24, Pa. One of the most importent bulletins in the series is devoted wholly to the subject of counting scales. Two of the brochures are devoted to bench scales and portable platform scales, respectively. Another describes the dormant platform scale line. The fifth bulletin is specialized to crane scales. The last is designed for the dairy industry. The most outstanding feature of the counting scale bulletin (P-714G) is an entire chapter or "How to Select the Right Scale," complete with tabular information and a discussion of proper ratio specification.

#### 35 Wire Rope Product

Tuffy Dragline, for all dragline operating conditions, is described in detail in a new bulletin prepared by Union Wire Rope Corporation, Kansas City, Mo. Results of tests and illustrations showing many uses of Tuffy draglines are included in the bulletin. Only 3 specifications are necessary for

ordering this new wire rope product: The length and size of rope required, and the name "Tuffy" dragline. The latter is identified by a trade character similar to those used for Tuffy slings, Tuffy chokers and Tuffy wire rope made for mining.

#### 36 **Pneumatic Rivet Passer**

A new Penfler folder on pneumatic rivet passers prepared by Pennsylvania Flexible Metallic Tubing Co., Philadelphia, Pa., gives the full details on how the rivet passer is used, how it saves time, prevents costly accidents and cuts production costs. In addition to pointing out the many advantages to be obtained by various industries, this folder gives full details on the construction of the rivet passer and how it can be installed on the particular job.

#### 37 **Metal Buildings**

A 6-page folder describing and illustrating the uses and advantages of standard Armco Steelox buildings has been issued by Armco Drainage & Metal Products, Inc., Middletown, O. Included are general data showing range of sizes, types of doors and windows, partitions, ceilings, louvres and ridge ventilators. The folder comes in three

editions describing the specific applications for which the buildings may be used by (1) industry in general, (2) the mining industry and (3) railways.

#### 38 Wire Rope Chart

In line with the recent formation of their Wire Rope Sales Division, R. G. LeTourneau, Inc., Peoria, Ill., has published a new Tournarope wall chart. This chart lists the features incorporated into the design and production of Tournarope; gives the types and constructions; and lists its applications in the earthmoving, hauling, and lifting equipment fields. On the inside fold of this 16 1/2 in. x 21 1/2 in. yellow and black chart are listed the cable requirements for Le-Tourneau scrapers, dozers, cranes and

#### 39 **Diesel Tractor**

A 32-page booklet titled, "The Caterpillar Diesel D4 Tractor," has been published by Caterpillar Tractor Co., Peoria, Ill., to bring the design and manufacturing points of this tractor before the user's eyes. The booklet contains engineer's drawings, cutaway sectional drawings and retouch photographs of the working parts of the tractor with explanatory copy of the salient points concerning manufacture.



- · PATCHING
- DRIVEWAYS
- TENNIS COURTS
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- · WATERPROOFING

#### DO YOU HANDLE ASPHALT **JOBS LIKE THIS?**

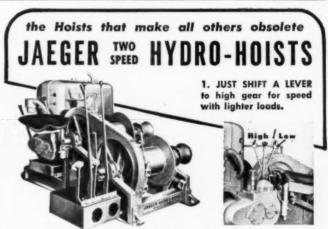
Or perhaps you have other types of asphalt problems! If yours is an asphalt problem here is the unit you need to handle those fast, small mixes.

The Foote Kinetic Mixer is portable - rubber-tire mounted. It is easily operated. It's fast and saves time. Mixes right on the job. Delivers 3 cu. ft. in 30 seconds. New mixing principle assures thorough mix. Ask for folder K-100 and name of representative nearest you.

# THE FOOTE COMPANY, INC. Subsidiary of Blaw-Knox Co. 1936 State Street Nunda, New York

Builders of ...

Adnun Black Top Pavers, Multi-Foote Concrete Pavers and Foote Kinetic Mixers



HYDRAULIC CONTROL - just like \$25,000 cranes.



3. AUTOMOTIVE TRANSMISSION pro vides interchangeable use of standard gas, electric or diesel power at efficient 1800 rpm.

4. FABRICATED STEEL THRUOUT - no broken side frames, drum flanges.

5. Instant releasing hydraulic clutches with single adjustment, air-cooled hy-draulic brakes, self-aligning bearing blocks, many advanced features.

POPULAR PRICED 25-40 HP "UTIL-ITY" MODELS: Gas or electric, 1 or 2 drums. Ask for Catalog HU-8.

60-100 HP "ERECTORS" MODELS: Gas, electric, diesel; 1, 2, or 3 drums. Ask for Catalog HE-8.

THE JAEGER MACHINE CO.

Main Office and Factory Columbus 16, Ohio

Philadelphia 7 Chicago 1 Birmingham 1 1504 Widener Bldg. 226 N. La Salle St. 235 American Life Bldg

COMPRESSORS • PUMPS • MIXERS • PAVING MACHINERY





The book also contains testimonial statements of tractor owners and pictures of many of the numerous operations on which the tractor is identified.

(Continued from page 73)
quite a storm. My suggestion of a simple cure for the situation would be to put a top limit on the maximum size aggregate allowed based on a square opening. My suggestion as to the maximum size aggregate to be used in a hot-mix pavement would be one-half the thickness of the course being laid, this maximum size to be based on square openings. In other words, if the course being laid is approximately 1½ in. thick, permit the maximum size of aggregate to be ¾ in. based on square opening.

#### State-Wide Coordination

Better and closer coordination between adjoining districts would reduce costs. At times it seems one district has no idea what is happening in the district next door, even though they are preparing plans for a road common to both districts. Also not enough thought is being given to combining several small jobs into one large job which can be handled from one set-up even though the two jobs are in different districts. This was



# PORTABLE ASPHALT PLANTS

Complete units for pavement maintenance. Capacities—4, 8, 12, 25 tons per hour.

OTHER PRODUCTS

FRONT END LOADERS
for Industrial Tractors

CONCRETE VIBRATORS

Gasoline Engine and Electric Motor Driven Models

HEATING KETTLES

AGGREGATE DRYERS

Write for Circulars

White Mig. Co.

**ELKHART** 

INDIANA



# "It's a Tough Fight, but" . . . Mud or Muck, the

tops with contractors. It's fast on its feet, easily maneu-

TROJAN wellerweight WINS verable in tight corners, ideal for haul roads, clean-up and finishing work. It has the heft, power, traction and flotation for practically any job. You'll find it's a mighty handy, cost-saving piece of equipment to own. Ask your

Trojan distributor for ringside details on the Welterweight

or write

CONTRACTORS MACHINERY CO., INC., BATAVIA, N.Y.



available from Stock for immediate Delivery

CONVEYOR, ELEVATOR and TRANSMISSION BELTING

V-BELTS all sizes

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DISCHARGE COMPRESSOR

PILE DRIVERS ROAD BUILDERS STEAM

VACUUM

SUCTION

WELDING

BOOTS, DREDGE SLEEVES, PUMP DIAPHRAGMS, ETC.

... and everything rubber

for Industrial Requirements

.... WRITE ..... WIRE

CO., Inc.

the case in the February letting when two jobs were let as separate jobs but could have been more economically handled from one set-up and as one job by one set of engineers.

In some districts the dressing up of a job before acceptance is being carried to extreme. A job should be cleaned up, but only to the degree the department intends maintaining. This item varies considerably from district to district and from engineer to engineer.

#### **Keep Items Separate**

The tendency to include more and more small items of work into one pay item should be stopped. If the contractor takes them into consideration as he should, his prices for the particular item are bound to be higher.

In conclusion, I wish to state that in my opinion the Texas highway department is making an honest effort to bring about any changes possible to lower costs and make bidding on jobs more of a calculation than a guess. I realize that some of the things we might think should be changed cannot always be done. However, in the past changes have been made which seemed just as radical, but after the rules got to working, the old method seemed silly and unduly expensive.

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- operating condition.

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- mower, in good operating condition.

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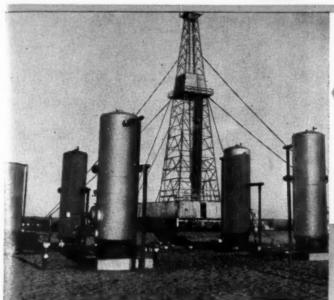
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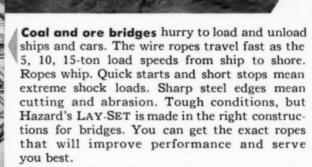
# Improved Performance with LAY-SET PREFORMED





"Make hole" deeper—faster—is the demand in the oil fields. The deeper the hole goes, the greater the weight of drill pipe and tools. The faster it goes, the greater the shock loads in pulling and running in pipe. Hazard makes LAY-SET Preformed in Seale construction, with tough improved plow steel wires, and an independent wire rope core. LAY-SET's improved performance makes it THE rope for deeper, faster drilling.

The powerful "cat" and ravenous carrier-scraper cut down hills and fill in valleys. They make modern roads, airports, dams, and industrial sites—yes, even remove overburden in strip mining operations. Hazard's LAY-SET Preformed Streamlined Scraper Cable is designed for the tortuous sheaves and reverse bends that prove the quality of the rope. It will improve the performance of your equipment.



Whatever the field — logging, mining, building elevator, contractor, industrial, marine, or oil — Hazard wire ropes give you improved performance.

ASK your distributor for LAY-SET <u>Pre</u>formed, Green Strand Wire Rope
In Business for Your Safety



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# HAZARD WIRE ROPE

Wilkes-Barre, Pa., Atlanta, Chicago, Denver, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, Portland, San Francisco, Tacoma, Seattle, Bridgeport, Conn.

# An important New Jersey State-Aid project





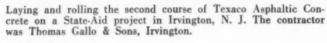


Traffic on Union Avenue, Irvington, N. J., now enjoys the resilient, joint-free qualities of this newly completed Texas Asphaltic Concrete pavement of the Fine-aggregate type.

Another worn, rough-riding pavement become a foundation for a resilient, heavy-duty Texam Asphaltic Concrete wearing surface. For the principal north-south thoroughfare in Irvington, N.J. a Fine-aggregate Asphaltic Concrete, laid in two courses, with a combined thickness of three inches, was specified.

Years of experience on a large mileage of its streets and highways has sold the state of New Jersey on the durability, economy and lasting riding comfort of this pavement type.

Whatever your street, highway or airport surfacing problem, there is a Texaco Asphalt Cement Cutback Asphalt or Slow-curing Asphaltic 01 exactly suited to your requirements. Every road builder should have on file copies of two helpful booklets which describe the wide range of road and street types constructed with Texaco Asphali products. A request to our nearest office will bring you copies of these publications, which are offered without charge.



THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17 Houston 1



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